"THE ENGINEER," FEBRUARY 22, 1929

With METALLURGICAL and BRITISH INDUSTRIES FAIR SUPPLEMENTS.

The Engineer.

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VOL. CXLVII.—No. 3815] LONDON: FRIDAY EVENING, FEBRUARY 22, 1929 [PRICE { WITH SUPPLEMENTS } ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

Air Ministry.

SALE by TENDER of MACHINE TOOLS, ELECTRIC MOTORS and other PLANT lying at the R.A.F. (Cadet) College, Cranwell, Lincs.

The plant is generally in excellent condition and consists of Lathes of well-known makers, including "Drummond," "Mascot," "Holbrook," "Capstan," "Lang," "Morris," "Mueller" and "Centaur;" Electric Motors of 1, 2, 4, 10, 20 and 70 H.P.; Milling, Grinding, Drilling, Shaping, Shearing and Planing Machines by well-known makers; Power Hammers, Cooking Apparatus, Marine and Portable Boilers, and other Plant.

The whole of the machines, &c., may be viewed at any time on application to the Senior Works and Buildings Officer at Cranwell, from whom Tender forms may be obtained. Tender forms can also be obtained on application to the DIRECTOR OF CONTRACTS, Air Ministry, Alexandra House, Kingsway, London, W.C. 2.

Tenders are returnable to the Air Ministry on or before 10 a.m. on 12th day of March, 1929. 1046

HEATING.

The Commissioners of

His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Friday, 15th March, 1929, for ACCELERATED LOW-PRESSURE HOT WATER HEATING at the "Terminus" Telephone Exchange, King's Cross, W.C.

Drawings, specification and a copy of the conditions and form of contract, bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W.1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 1048

The Director-General,

India Store Department, Belvedere-road, Lambeth, London, S.E. 1, invites TENDERS for:—

SCHEDULE 1.—708 PAIRS DISC WHEELS and AXLES.

SCHEDULE 2.—300 CAST STEEL AXLE-BOXES for LOCOMOTIVES.

Tenders due as follows:—
Schedule 1, 8th March, 1929.
Schedule 2, 12th March, 1929.

Forms of Tender available from the above at a fee (which will not be returned) of 5s. for each Schedule. 1085

War Department Sale.

TENDERS are INVITED for the WHOLE or PART of ONE GENERATING SET, as under:—

One Hornsby Single-cylinder Horizontal Paraffin Oil Engine, Makers' No. 1492.
25 H.P. at 180 revs. per minute.
Cylinder 16in. diameter by 20in. stroke.
Fly-wheel 6in. diameter by 6 7-8in. face.
Pulley 6in. diameter by 11in. face.
Valves, mushroom.
Lubrication: Drip feed to cylinder, sight feed and syphon to big end, remainder syphon.

One D.C. Generator, 200 amps. at 80 volts.
Makers, E.C.C., No. 4131.
Open type, compound wound.
Bipolar with two sets wire gauze brushes, two brushes per set.
Belt driven by above engine.
Pulley diameter 19¼in., face 11in., r.p.m. 640.

The set, which is complete with approx. 40ft. of leather link belt, may be seen at the Headquarters, East Riding R.E. (T.) Fortress Company, Colonial-street, Hull, between 9 a.m. and 12 noon or 1 p.m. and 4 p.m.

Forms of Tender may be obtained from THE COMMANDING ROYAL ENGINEER, West Riding Area, 13, Wenlock-terrace, York. 1013

Applications are Invited for APPOINTMENTS as:
1. LECTURER in MECHANICAL ENGINEERING.
2. LECTURER in CIVIL ENGINEERING.

At the Government Technical Institute, Insein, Burma.

Candidates for (1) should possess an Honours Degree in Engineering and have had experience both in teaching and in engineering work. Preference will be given to an applicanat with experience in the design, construction and working of internal combustion engines.

Candidates for (2) should possess a Degree (preferably an Honours Degree) of a British University and have had experience in teaching and in the design and construction of civil engineering works.

Conditions for either appointment:—

Salary at fixed rate of Rs. 1100 a calendar month. Agreement for three years. Free first-class passages out and home. Provident Fund. Strict medical examination. Age preferably not less than 30 years.

Full particulars and forms of application may be obtained upon request by postcard to the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 2nd March, 1929. 1044

Vacancies for Aeronautical Examiners in Aeronautical Inspection Department. Qualifications required, good general and technical education, thorough engineering training with experience in testing aircraft metallic and non-metallic materials and experience in either—

(A) FOR AIRCRAFT EXAMINERS:
Construction aircraft components and assembling complete aircraft and testing installation of aero engines; or

(B) FOR ENGINE EXAMINERS:
Manufacture engine components and inspection complete aircraft engines; knowledge general principles brake testing and measurement of horse-power.

Annual salary £175-£10-£225 plus Civil Service bonus (present aggregate £259-£322).

Apply, SECRETARY, Air Ministry (I.G.), Kingsway, W.C. 2. 1047

The Engineer

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PUBLIC NOTICES

CHIEF MECHANICAL ENGINEER FOR HOLTON HEATH.

Chief Mechanical Engineer REQUIRED for R.N. Cordite Factory, Holton Heath, near Wareham, Dorset. Qualifications:—Sound knowledge of mechanical and electrical engineering and practical experience in the upkeep and working of factory machinery. Ex-Service man preferred. Salary £400-600, with Civil Service bonus—at present £137 on £400.—Apply by letter, giving full particulars of qualifications, diplomas, experience, &c., to the SECRETARY OF THE ADMIRALTY (C.E. Branch), Admiralty, S.W. 1. Appointment would be during the pleasure of the Admiralty, and would be on an unestablished basis and limited to 5 years in the first instance, with possibility of extension. 1045

The University of Sheffield.

IRONMONGERS' COMPANY RESEARCH FELLOWSHIP AND SCHOLARSHIPS.

A Department for Research on the Cold Working of Steel and other Ferrous Metals in the University of Sheffield having been established by the generous aid of the Worshipful Company of Ironmongers, together with certain firms in the Wire-drawing and Cold-Rolling Industry, the University will proceed shortly to the APPOINTMENT of an IRONMONGERS' COMPANY RESEARCH FELLOW, at a salary of £500, and of TWO IRONMONGERS' COMPANY RESEARCH SCHOLARS, the annual value of each Scholarship being £150. The Department will be equipped with modern plant for cold-rolling, drawing and other forms of cold-working, and for the investigation of the properties of cold-worked materials.

The Research Fellow should have experience in metallurgical research, whilst for the Research Scholars preference will be given to candidates with special qualifications in engineering and in physics respectively.

Terms of appointment may be obtained on application to the undersigned. Applications should be received on or before April 1st, 1929.

W. M. GIBBONS, Registrar.
1057

PUBLIC NOTICES

Administrative County of LONDON.

HAMMERSMITH-ROAD AND BROOK GREEN WIDENINGS.

The London County Council invites TENDERS for PAVING the ADDED AREAS for the Widening of Hammersmith-road and Brook Green, comprising Creosoted Deal and Asphaltic Macadam Carriageways, Artificial Stone Footways, and Granite Kerb and Channelling.

The specification, form of Tender, drawing, &c., may be obtained on application to the Chief Engineer, the Old County Hall, Spring-gardens, S.W. 1, upon payment of £2 by cheque, draft or money order to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before payment of the fee.

Remittances by post should be addressed to the Chief Engineer at the Old County Hall, Spring-gardens, S.W. 1. Personal inquiries at Room 3A at No. 3, Warwick House-street, Cockspur-street, S.W. 1.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in "The London County Council Gazette."

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 11th March, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX, Clerk of the London County Council.
1050

The Directors of the Egham and Staines Electricity Company, Ltd., are prepared to receive OFFERS for:—

ONE 500 B.H.P. English Electric DIESEL ENGINE direct coupled to ONE 2200-Volt, Single-phase, 50 Cycles ALTERNATOR.

Particulars of the plant from the MANAGER, Electricity Works, Staines. 1068

PUBLIC NOTICES

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for:—

CARRIAGE UNDERFRAMES with Bogies, OPEN and COVERED GOODS UNDERFRAMES with Bodies, and CABOOSE BRAKE VAN UNDERFRAMES, 2ft. 6in. gauge.

Specification and form of tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after Thursday, 21st February, 1929.

A fee of 20s. will be charged for each copy of the specification, which is NOT returnable.

Tenders must be submitted not later than NOON on Tuesday, 5th March, 1929.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
E. C. VOLKERS, Secretary.
1074

Madras Port Trust.

APPOINTMENT OF EXECUTIVE ENGINEER TO THE PORT OF MADRAS.

APPLICATIONS, in writing, for the above APPOINTMENT will be received by the undersigned on behalf of the Trustees of the Port of Madras up to 8th March, 1929.

Candidates must have previous practical experience on Dock and Harbour Works, and preferably a knowledge of Reinforced Concrete Design and Construction.

SALARY.—Rupees 1250 per mensem, rising by annual increments of Rs. 50 to Rs. 1550 per mensem, with free quarters or Rs. 150 house allowance.

The selected candidate will be required to join as soon after the end of March, 1929, as possible. Applicants should forward copies of testimonials (which will not be returned), and also particulars of nationality, education, age, diplomas or degrees, accompanied by a record, in chronological order, of candidate's training and subsequent experience.

The selected candidate will be required to enter into an agreement for a period of three or five years, and will be provided with free first-class passage for himself to Madras, and return passage to England on termination of his agreement, subject to the conditions of his agreement.

RENDEL PALMER and TRITTON, 12-15, Dartmouth-street, London, S.W. 1. 1072

The National Boiler and GENERAL INSURANCE CO., Ltd., St. Mary's Parsonage, Manchester, REQUIRE additional INSPECTORS in the Lift and Crane Department. Applicants should be between 25 and 35 years of age and be prepared to reside in any part of the country; must be practical engineers with actual experience in construction, erection and repair of Lifts and Cranes; also must have recognised theoretical qualifications and be able to make dimensioned sketches. Duties include the examination and tests of all classes of lifts, cranes and other lifting appliances. Salary to commence £260 per annum.—Apply in own hand writing, by letter only, marked "Lift and Crane Inspector," giving age, outline of practical training and experience, particulars of theoretical training, and copies of testimonials, to EDWARD G. HILLER, Chief Engineer and General Manager. 990

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, an ENGINEER. Age About 30, with University training. Cambridge preferred; first-class Engineering knowledge and capacity for Invention and Design are essential. To develop new work in a special field for a long-established firm of manufacturing engineers.—Address, stating age, education, full details of training and experience, and enclosing copies of testimonials and references, 1062, The Engineer Office. 1062 A

WANTED, Competent ENGINEER for New Factory in the Midlands. Must be experienced in supervision of Power-house, Electrical Maintenance and Workshop Machinery Maintenance Departments. Permanency to first-class man. State age, experience, salary required.—Write, MANAGER, Pirelli Ltd., Burton-on-Trent. 961 A

WANTED, COMPETENT RATE FIXER for Machine Shop; only men conversant with Machining Steel Castings to fine limits for the Commercial Vehicle Industry and experienced regarding cutting feeds and speeds need apply.—Address, giving full particulars of experience, age, and remuneration required, 1052, The Engineer Office. 1052 A

WANTED, ENGINEER, Chemical Works, to Take Charge Power, Services, D.O., Assist Developments; University Graduate with at least 5 years' practical experience.—Address, 1068, The Engineer Office. 1068 A

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SITUATIONS OPEN (continued)

WANTED, ENGINEER, Used to Maintenance of Machinery and Plant. Must have Millwright's, Drawing-office and Costing experience. Permanency to first-class man. State age, qualifications, salary required.—Write, MANAGER, Pirelli Ltd., Burton-on-Trent. 963 A

WANTED, ENGINEER, to Take Charge Power Services D.O. Development in Chemical Works, University graduate with at least 5 years' practical experience.—Address, P5551, The Engineer Office. P5551 A

WANTED, London District, ENGINEERING TRAVELLER and OUTSIDE SUPERVISOR for firm manufacturing Elevators and Conveyors, also General Engineers and Contractors. Applicant must have established connection.—Address, giving full particulars experience and salary required, 1083, The Engineer Office. 1082 A

WANTED, ONE or TWO YOUNG ENGINEERS for India. Well-trained men who could qualify for promotion required. Oil Engine Experience an advantage. State age, training.—Address, 1024, The Engineer Office. 1024 A

WANTED, POWER-HOUSE ENGINEER, Experienced in supervision of Water-tube Boilers, Pumping Plant, Air Compressors, &c. Permanency to first-class man. State age, experience, salary required.—Write, MANAGER, Pirelli Ltd., Burton-on-Trent. 962 A

WANTED, University-trained ENGINEER, Age 30-35; experience of Experimental and Development Work essential; knowledge of Power Transmission an advantage.—Write, giving fullest particulars as to training, experience, firms worked for, age and salary required, 1019, The Engineer Office. 1019 A

WANTED, Well-educated YOUNG MAN (Single, aged about 20/25) for Workshop in Ceylon; experience in Engineering Accounts, Costing, and Stores desirable; 5 years' agreement; commencing salary Rs. 500/- per month; with annual increments of Rs. 50/- per month. Free passage out and home.—Write, giving full particulars and qualifications, to "E. N.," c/o Street's, 6, Gracechurch-street, E.C.3. 1030 A

ASSISTANT PLANT ENGINEER.—Young Capable MAN, with up-to-date experience in modern production methods and in maintenance of plant, REQUIRED by large Firm of Engineers in West London.—Address, stating full details of training and experience, age, &c., 1080, The Engineer Office. 1080 A

ASSISTANT to GENERAL MANAGER REQUIRED by large progressive concern in Light Engineering Trade. Man selected will have to prove definite experience as Assistant to Chief Executive of large well-organised concern of similar type, accustomed to handling detail work and capable of deputising for his chief. Must be capable of preparing statistics in tabloid form and preferably with practical accountancy experience, in addition to executive capacity. The concern possess several works of considerable importance, and tact in dealing with managers will have to be proved. Excellent remuneration and prospects offered. Age not to exceed 40.—Write in confidence, first instance, addressed "ENGINEERING," c.o. Pool's Advertising Service, 180, Fleet-street, London, E.C. 1021 A

ASSISTANT WORKS MANAGER WANTED IMMEDIATELY by large established concerned engaged in the Manufacture of Automatic Vending Machines, Automatic Weighing Machines, and other engineering products; must have sound experience on modern lines in progressive up-to-date concern, and be accustomed to and capable of handling large staffs with tact and productive efficiency. Salary up to £700 with good prospects for really useful man. Write, with fullest particulars past and present concerns in confidence. State age.—Address, 1012 The Engineer Office. 1012 A

CHIEF CHEMIST and METALLURGIST to Take Charge of Works Laboratory, situated about 30 miles from London and dealing with the Testing of Steels and Non-ferrous Alloys, including Heat Treatment; also Oils, &c. State age, experience and salary required.—Address, 1042, The Engineer Office. 1042 A

DESIGNS ENGINEER REQUIRED, Primarily for Wireless Transmitting or Receiving Gear. Full college training and shops experience essential.—Write, giving age and full particulars of training, experience and salary required, to MARCONI'S WIRELESS TELEGRAPH CO., Ltd., Chelmsford. Envelopes to be marked "Designs Engineer, Private." 1043 A

ENGINEER ASSISTANT WANTED for a Tea Garden in Northern India; must be educated at a public school, single, between 21 and 25, and fully qualified Mechanical Engineer, with experience of I.C. Engines and Electricity. Salary Rupees 350 per mensem, and first-class passage.—Write, with full particulars, to "W. X.," c.o. J. W. Vickers and Co., Ltd., 24, Austin Friars, E.C. 2. 1015 A

ENGINEER, Fully Experienced in Structural Design, specialising Reinforced Concrete. WANTED by Consulting Engineer, London. Only those with highest qualifications and able to take complete charge should apply.—Address, P5520, The Engineer Office. P5520 A

ENGINEER REQUIRED by Well-known Eastern firm for South India. Qualifications: Structural and Mechanical Draughtsman, with knowledge of Estimating. First agreement 5 years; first-class passage and outfit allowance. Healthy climate, good prospects; age 22-25.—Address, with full details, 1020, The Engineer Office. 1020 A

ENGINEERS REQUIRED FOR DESIGNING AND ESTIMATING Heavy Duty Cranes and Machinery, Hydraulic Regulating Gates and Movable Bridges. Must have good technical training and experience along these lines, and ability to handle such engineering work to completion on own initiative with capacity for advancement. Not over 35 years of age. Apply, giving full personal particulars, salary expected, also training and experience, outlining exactly duties performed, to DOMINION BRIDGE COMPANY, Limited, Box 4016, Montreal, Canada. 953 A

OLD-ESTABLISHED ENGINEERING COMPANY in India REQUIRE a YOUNG MAN of good address and personality, not over 23, must be single, with technical training and salesmanship, experience in Hardware and Metals.—Write fully, stating age, education, training, and experience, also present employment and salary, Z.J. 555, c/o Deacon's Advertising Agency, Fenchurch-avenue, London. 1070 A

OPENING AVAILABLE with Firm of Westminster Export Engineers for JUNIOR who has served apprenticeship to be trained in commercial business. Public school boy preferred. Commencing nominal salary 30s. per week; prospects in India.—Address, giving details of apprenticeship and refs., P5533, The Engineer Office. P5533 A

PIPE MANUFACTURERS REQUIRE Experienced SALES MANAGER with good connections amongst water engineers, &c. State qualifications, age, experience, and salary required, and send photo.—Address, P5541, The Engineer Office. P5541 A

RATE FIXER and INSPECTOR for Small General Engineers' works in the Midlands, employing about 100 hands, manufacturing Colliery Plant and general machinery. State age, experience and salary required.—Address, 1059, The Engineer Office. 1059 A

REQUIRED by a Firm of Iron and Steel Manufacturers, an ASSISTANT SALES MANAGER for their Indian Branch. Only applicants with both Manufacturing and Sales Experience will be considered. Commencing salary £600 per annum. State age, training and full particulars, which will be treated in strict confidence.—Address, 1041, The Engineer Office. 1041 A

YARROW HOME and HOSPITAL
FOR CHILDREN
BROADSTAIRS.

For the Early & Preventive Treatment of Disease & Convalescence after Illness.

The Hospital is intended for the children of Members of the Institution of Civil Engineers, the children of architects, artists, authors, clergymen, members of the medical, legal, and other professions, members of scientific societies, officers of the Navy, Army, and Royal Air Force, officers of the Merchant Navy, schoolmasters and university professors.

Accommodation is provided for 50 Boys between the ages of 4 and 12 years, and 50 Girls between the ages of 4 and 14 years. In special cases the age limits may be raised to 14 for Boys, and 16 for Girls.

Fee 21/- per week, or as may be arranged, and travelling expenses.

Particulars can be obtained from the Secretary:—

116, Victoria Street, Westminster, LONDON, S. W. 1.

SITUATIONS OPEN (continued)

SALES ENGINEER REQUIRED in London, with thorough knowledge of Steam Generation Plant and Accessories; experience in handling district agents, with the gift of leadership, coupled with enthusiasm and imagination. Recognised as a successful salesman with expert knowledge of modern salesmanship. Age between 30 and 40. Salary and commission. The right man would have exceptional prospects. Applications will be treated in strict confidence, and should be accompanied by full particulars of selling experience.—Address, 1038, The Engineer Office. 1038 A

TECHNICAL PUBLICITY MANAGER, Young, with previous experience of technical journalism and technical advertising, to undertake whole time Publicity Work in connection with Electrical—Hydraulic, Textile, and Fire Engineering productions.—Apply by letter only, in own handwriting, giving full particulars of training, attainments, and experience, also salary required, to "APPOINTMENTS," Mather and Platt, Ltd., Park Works, Manchester. 1060 A

THE BRITISH ENGINE, BOILER and ELECTRICAL INSURANCE CO., Ltd., 24, Fennel-street, Manchester, REQUIRE an ASSISTANT ENGINEER for their Lift and Crane Department. Applicants should have had practical and theoretical training and be able to make dimension sketches. Knowledge of correspondence an advantage. Age 21-25. Salary to commence £200 per annum.—Apply by letter only, marked "Cranes and Lifts," giving outline of practical experience, particulars of certificates of theoretical knowledge and copies of testimonials, HARRY M. LONGRIDGE, Manager. 1033 A

WANTED by Crane Firm in Midlands, LEADING DRAUGHTSMAN for small Drawing-office; must be capable in all branches of Jib Crane Design. Permanency for suitable man. State age, experience and salary required.—Address, 1031, The Engineer Office. 1031 A

WANTED, CHIEF DRAUGHTSMAN for Low-temperature Carbonisation Work; must be experienced in Design of Condensation Systems, Retort Plants, Steel Plate and Structural Work.—Write, stating qualifications, age, experience and salary required, to SENSIBLE HEAT DISTILLATION, Ltd., York Mansion, Petty France, London. 1017 A

WANTED, Experienced CHIEF DRAUGHTSMAN for Supervising Drawing-office of 8/10 men, preferably man with General and Machine Tool experience, able to make calculations and assist head of maintenance departments. Permanency to first-class man. State age, qualifications, salary required.—Write, MANAGER, Pirelli Ltd., Burton-on-Trent. 964 A

WANTED, First-class JIG and TOOL DRAUGHTSMEN, accustomed to Aero-engine Components; only first-class men need apply.—Apply by letter only to GILLETT, STEPHEN and CO., Ltd., Atlas Works, Bookham, Surrey. 1034 A

WANTED, IMMEDIATELY, Neat and Accurate LADY TRACER by Westminster firm. State experience and salary required.—Address, 1023, The Engineer Office. 1023 A

WANTED, JUNIOR DRAUGHTSMAN for Engineering Works in London, N.1 district, age about 18 to 20. State experience and salary required.—Address, P5529, The Engineer Office. P5529 A

WANTED, JUNIOR DRAUGHTSMAN for General Engineering Works, Electrical and Mechanical. State experience, age, and salary reqd. London applicants only.—Address, P5538, The Engineer Office. P5538 A

WANTED, Well-trained JUNIOR DRAUGHTSMAN for Oil Engine Work; excellent prospects for right man. State qualifications, experience and salary required.—Address, 1018, The Engineer Office. 1018 A

CAPABLE DRAUGHTSMAN REQUIRED, Experienced in Shovels and Cranes.—Write, giving full particulars as to experience, qualifications, age and salary, to Box 924, T. B. Browne's Advertising Offices, 163, Queen Victoria-street, London, E.C. 4. 1055 A

CHIEF DRAUGHTSMAN.—A VACANCY WILL OCCUR SHORTLY for above, with a medium-sized but enterprising firm manufacturing D.C. and A.C. Electrical Machinery. Applicants must have necessary technical qualifications and experience and also be resourceful and able to co-operate in securing improvements necessary to modern economic practice in similar work. Full particulars of training with approximate salary required to be sent in strict confidence.—Address, 1032, The Engineer Office. 1032 A

DESIGNER and CHIEF DRAUGHTSMAN REQUIRED to Take Charge of Drawing-office in Works manufacturing Accurate Machinery. Must have had considerable Machine Shop experience.—Address, stating age, experience, and salary required, 992, The Engineer Office. 992 A

DRAUGHTSMAN-ESTIMATOR REQUIRED for London firm of Heating and Ventilating Engineers.—Write, stating age, salary and experience, to Box 130, Samson Clark and Co., Ltd., 57, Mortimer-street, W. 1. 1022 A

DRAUGHTSMAN for Heavy Oil Engines, Land Type.—Address full particulars, age, and salary required, 858, The Engineer Office. 858 A

DRAUGHTSMAN (Not Junior) for Pumping Machinery, Reciprocating and/or Centrifugal.—Address, stating age, experience, salary required, 857, The Engineer Office. 857 A

DRAUGHTSMAN.—PRODUCTION DRAUGHTSMAN, capable of preparing complete manufacturing drawings and supervising production. Good office and works experience in Light Mechanical and Electrical Work essential.—Letters only, with full particulars and salary, to GENERAL ENGINEERING DEVELOPMENT TRUST, Ltd., 38, Gordon-square, London, W.C. 1. 1071 A

SITUATIONS OPEN (continued)

DRAUGHTSMAN.—REQUIRED, in London Office of Firm of Engineers, DRAUGHTSMAN with knowledge of Conveying and Mechanical Handling Plants. Experienced men only need apply. State age, experience, and salary required.—Address, 1073, The Engineer Office. 1073 A

DRAUGHTSMAN REQUIRED, Must Have Sound D.O. experience in Steel Works Equipment and be capable of taking responsibility for own work.—Address, 1084, The Engineer Office. 1084 A

DRAUGHTSMAN REQUIRED, with Experience Industrial Heating and the Design of Conveyor Mechanism.—Address, stating experience and salary required, 1025, The Engineer Office. 1025 A

DRAUGHTSMAN REQUIRED, with Good Experience of Elevating and Conveying Machinery. State age, qualifications, and salary required.—ATLAS WORKS, Pershore. P5547 A

DRAUGHTSMAN WANTED by Large Engineering firm in the City, with experience of Pipework Lay-out; good technical qualifications essential.—Address, stating age, experience and salary required, 1063, The Engineer Office. 1063 A

DRAUGHTSMAN WANTED for Midland Country district, experienced in the Design of Slow-speed Engines for high-class Pumping Installations; experience with Colliery Plant an additional advantage.—Address, stating age, experience and salary required, 1026, The Engineer Office. 1026 A

DRAUGHTSMAN, with Experience of Hand and Electric Overhead Runways; must be competent to take accurate particulars for manufacturing purposes.—Address, stating age, experience and salary required, 1039, The Engineer Office. 1039 A

INDIA.—REQUIRED, CARRIAGE and WAGON ESTIMATOR DRAUGHTSMAN. Must have good knowledge of design, also experience in large Carriage and Wagon Works. Five years' agreement, free passage out and home. Single man preferred.—Write, with full particulars of experience and copies of testimonials, to Z.O. 559, c/o Deacon's Advertising Agency, Fenchurch-avenue, London. 1069 A

JIG and TOOL DESIGNER REQUIRED in Works situated about 30 miles south of London. Only those who have had experience on Automatic Machinery and similar work need apply.—Address, stating age, experience, and salary required, 991, The Engineer Office. 991 A

JUNIOR DRAUGHTSMAN REQUIRED by Civil Engineers in Westminster, with some experience in calculations and detailing for Steel-framed Buildings. State age, experience, and salary required, P5530, The Engineer Office. P5530 A

JUNIOR DRAUGHTSMAN REQUIRED in Engineering Works, South of England, experience in Centrifugal Pump and Refrigerating Machinery an advantage.—Address, stating age, experience and salary required, 1056, The Engineer Office. 1056 A

JUNIOR DRAUGHTSMAN REQUIRED, with at least one year's experience on Press Tool Drawing.
Apply in writing, stating age, experience and salary required, to J. PAYEN, Ltd., Church Wharf, Chiswick, W. 4. P5526 A

JUNIOR JIG and TOOL DRAUGHTSMAN REQUIRED, large Engineering Works, 30 miles London; workshop training essential. State age, experience and salary required.—Address, 1054, The Engineer Office. 1054 A

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ENGINEER DESIGNER, Wh. Ex., of Varied experience, at present engaged with a large firm on important Government work, is DESIROUS of a CHANGE, preferably in the London district.—Write, Box 1504, c.o. Brown's, 39, Tothill-street, S.W. 1. 1049 B

ENGINEER (32), Ex 1st Class B.O.T., Steam, Motor 3½ yrs. drawing-office, DESIRES OPENING with Consulting Engrs. or other responsible post.—Address, P5540, The Engineer Office. P5540 B

FRENCH MECHANICAL ENGINEER, wide Experience workshop and sales, good address, well introduced in France, perfect technical and commercial English and French, educated England and France, OPEN to APPOINTMENT as AGENT, &c., for introducing in France any new engineering products, machine tools, &c.—Write, BART, c.o. Monsieur Fournier, 7, Rue du Faub. Saint Martin, Paris. P5535 B

GENERAL or WORKS MANAGER, M.I. Mech. E., DESIRES CHANGE; successfully controlling engineering works, steel and ironfounders, constructional and electrical work. He has had exceptionally broad experience, covering administration, organisation, commercial, technical and practical, up-to-date modern production and cost methods, both repetition and non-repetition, and big enough to take sole responsibility and produce dividend-paying results.—Address, P5546, The Engineer Office P5546 B

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For continuation of Small Advertisements see page 4.

A Seven-Day Journal

Navy Estimates and New Construction.

WE understand that the Navy Estimates for 1929–1930 will be published on or about March 11th. Unless unforeseen "cuts" have been made in the building programme, the Estimates will call for the construction of three cruisers, an aircraft carrier, nine destroyers, six submarines, and a net-laying vessel, this batch of ships terminating the five-year programme which Parliament adopted in August, 1925. In the meantime the official confirmation of the placing of contracts for naval vessels authorised under the 1928–29 Estimates is still awaited. We are credibly informed, however, that the allocation of this work will be as follows:—One 10,000-ton cruiser for Portsmouth Dockyard; one 10,000-ton cruiser and two sloops for Devonport Dockyard; one submarine and one submarine depôt ship for Chatham Dockyard; a flotilla leader and two or more submarines for Vickers-Armstrongs, Ltd.; two destroyers each for Palmer's Shipbuilding and Iron Company, Hawthorn, Leslie and Co., Swan, Hunter and Wigham Richardson, and John Brown and Co. The remaining submarines have been awarded to Beardmores, and the river gunboat presumably to Yarrow and Co. There is at present no information as to the placing of contracts for the two sloops which are to be built by private firms. Apart from the dockyard work, the orders enumerated are estimated to have a total value well in excess of £6,000,000. It is believed that the great delay in the award of contracts for naval construction under the current Navy Estimates has been due in part to Budget reasons and in part to considerations of policy, the nature of which may be easily surmised.

The First British Aeroplane Flight.

THE tradition that the first flight on a heavier-than-air power-driven machine in this country by a British subject was performed by Mr. A. V. Roe, at Brooklands in June, 1908, will die hard. But that it must die is the decision, just announced, of a Committee of the Royal Aero Club, appointed last December to determine the point. The Committee consisted of Lord Gorell, Captain G. de Havilland, and Lieut.-Colonel W. Lockwood Marsh. Its decision is no doubt a matter of definition. The Committee began its labours by deciding that "free flight in an aeroplane occurs when the machine, having left the ground, is maintained in the air by its own power on a level or upward path for a distance beyond that over which gravity and air resistance would sustain it." Three claims were submitted. The earliest was that of Mr. A. H. Phillips, who submitted particulars of a flight made in 1887. It was dismissed together with Mr. Roe's claim, in favour of that submitted by Lieut.-Colonel Moore-Brabazon, whose flight at Eastchurch on May 2nd, 1909, is regarded by the Committee as having been substantiated, and as being the first by a British subject within the British Isles. On that occasion Mr. Moore-Brabazon, as contemporary reports show, performed flights ranging from 150 to 500 yards. Mr. Roe's earlier attempts, being in the nature of a series of "hops," were, presumably, excluded from recognition in that they failed to reproduce the requirements of free flight as defined by the Committee.

The New P. and O. Turbo-Electric Liner Viceroy of India.

THE trials of the new twin-screw turbo-electric liner "Viceroy of India," built by Alexander Stephen and Sons, Ltd., at Linthouse, for the Peninsular and Oriental Steam Navigation Company, Ltd., have been prolonged owing to fog in the Firth of Clyde and are now in course of completion. On Tuesday last, the 19th inst., over two hundred representatives of shipping, shipbuilding and marine engineering interests visited the ship, and a run was made over the measured mile course. All those who were present spoke in the highest terms of the well laid-out passenger accommodation and the electrically-driven propelling machinery, and joined in congratulating the builders, the owners, and their advisers on the conspicuous success of their forward step. The "Viceroy of India" has a length of 612ft., with a beam of 78ft., and on trial she had a displacement of 19,086 tons. She is propelled by two 9000 kW turbo-alternator sets supplied with steam from six oil-fired Yarrow boilers working at a pressure of 350 lb. per square inch, with a total steam temperature of 700 deg. Fah. Special regenerative condensers working in conjunction with the Weir closed feed system are fitted. The two propelling motors each have a designed output of 8500 S.H.P. at 109 r.p.m., and with one alternate set in operation the guaranteed speed of the ship was 16½ knots and with both alternator sets over 19 knots. The whole of the main propelling machinery has been designed and supplied by the British Thomson-Houston Company, Ltd., of Rugby, and several of the auxiliaries work on the "Austin" constant current system. So far the visibility conditions on the measured mile have only permitted trials to be run with one alternator set in operation. The results are most gratifying. At 10,410 S.H.P. output the speed of the ship was 17·1 knots, against the guarantee of 16½ knots. There is no doubt that both with regard to output and fuel consumption the guaranteed figures will be improved upon. It is interesting to note that only four boilers with twenty furnaces were required for this output, compared with forty-eight furnaces for a similar output and speed on the newer P. and O. liners of the "Ranchi" and "Ranpura" class.

The Chamber of Shipping.

AT the fifty-second annual meeting of the Chamber of Shipping of the United Kingdom, which took place in London on Thursday, February 21st, the annual report was presented, and the newly elected President, Sir William Currie, gave his address. Sir Arthur M. Sutherland was elected Vice-president. A resolution affirmed the conviction that safety of life at sea could be promoted by the establishment and recognition of international uniform standards which were based on the experience of the most competent authorities in all maritime nations. The Chamber will co-operate towards this end with the British and other Governments in the forthcoming Conference on the Safety of Life at Sea in April next. It will also continue to co-operate with the International Shipping Conference, the International Chamber of Commerce, and the Comité Maritime International in an effort to secure international agreement on this question. The Chamber also welcomed the effort made by the International Shipping Conference to secure the general adoption of a load line, and urged all Governments to make an effort to establish an international agreement as to load-line regulations and their observance. In the report of the Chamber, which contains some very useful statistics, tables and diagrams, it is stated that before the war Great Britain was constructing about 60 per cent. of the world's ships, whereas to-day she is only building about 47·5 per cent. Despite this decrease, fifty ships are being built in Great Britain to every four in America and in Japan, every seven in Italy, five in France, and thirteen in Germany. Motor shipbuilding increased by 27 per cent. during 1928, while the steam tonnage only increased by 1·2 per cent. The determination of British owners to turn to good account our coal supplies is now becoming more marked.

Unwanted Aircraft Carriers.

ACCORDING to advices from Washington, the Navy Department has decided to take the drastic step of scrapping the aircraft-carriers "Lexington" and "Saratoga," which have been in commission only about sixteen months. These vessels, it will be recalled, are the largest, fastest, and most expensive representatives of their type in the world. They belonged originally to a group of six battle-cruisers authorised for the United States Navy in 1916, but not laid down until after the war. The displacement was to have been over 43,000 tons, the turbo-electric machinery was to have had an output of 180,000 S.H.P., and the main armament was to consist of eight 16in. guns. Four of these ships were cancelled as a result of the Washington Treaty, while the "Lexington" and "Saratoga" were reserved for conversion into aircraft-carriers. As modified their "standard" displacement was reduced to 33,000 tons and the armament to eight 8in. guns, but the original machinery was retained. Each cost £9,000,000 to complete. Turbine blading trouble developed during the trials, but these defects were made good, and both ships have recently logged a speed of 34 knots. It appears, however, that the cost of maintaining these enormous vessels in commission is proving prohibitive—£750,000 to £1,000,000 is mentioned as the annual charge for upkeep in each case—and American naval opinion is also concerned on the score of their vulnerability. They are barely able to pass through the Panama Canal, and in time of war they would prove a source of embarrassment to the American Fleet owing to the special measures which would have to be taken for their protection. Both ships are therefore to be scrapped as soon as one or more of the smaller aircraft carriers of about 14,000 tons become available for service.

Electric Supply Control.

ONE of the principal public utility companies in the United States, namely, the Utilities Power and Light Corporation, announces the acquisition through the London and Counties Trust, of the entire capital stocks of seven of the principal British power companies and substantial interest in others. The American company has apparently acquired the entire ordinary shares of the Greater London and Counties Trust, thus indirectly obtaining control of the Bedfordshire, Cambridgeshire and Huntingdonshire Electric Supply Company, the Cookham and District Electric Corporation, the East Anglian Electric Supply Company, Edmonton's Electricity Corporation, the Oxford Electric Company, the Wessex Electricity Company, and the Western Electricity Supply Company. Lord Birkenhead is stated to have accepted the chairmanship of the Greater London and Counties Trust. The extensions and developments which will be necessary in the areas served by these companies, will require within a period of five years an expenditure of £10,000,000, and ninety-five cities and towns in England will be affected. In the House of Commons Mr. W. Willock recently asked the Minister of Transport if he was aware of the arrangement, and, if so, whether he would consider in what ways the step would affect British interests. In reply, Colonel Ashley said that he had seen references to the matter in the Press, but as to the point raised in the second part of the question, he could not say anything more than that it had engaged his attention.

The London Traffic Agreement.

THE Bills promoted by the London County Council and the London Electric Railways Companies, designed to give them power to enter into working agreements with respect to the handling of traffic within the London area, have, as was anticipated, excited much hostility on their presentation to Parliament. The second reading debate was begun on Tuesday evening in the House of Commons, but under pressure from the Liberal and Labour benches, the Government consented to provide another half day on Tuesday of next week for the completion of the debate. The Liberals dislike placing a share of the control of municipal tramways in the hands of a private company. The Labour Party strongly opposes the principle of co-ordination as proposed in the Bills, on the ground that it is in conflict with the fundamental principles of Socialism. The Bills have been made the subject of a report submitted to the Minister of Transport by the London Traffic Advisory Committee. The Committee considers that in view of the urgency of the problem with which the Bills attempt to deal, the Minister should be advised to assist their passage, provided amendments are introduced to strengthen the safeguards which it deems necessary to protect the interests of the public.

Weak Bridges.

IN the House of Lords on Thursday of last week the Government introduced a Bill to deal with weak bridges over railways, canals, &c., which at present have to be maintained by their owners only in a condition suitable for the traffic which existed at the time the bridges were built. For over three years negotiations on the maintenance of these bridges have been proceeding between the Railway Companies' Association, the Canal Association, and the County Councils' Association, with the assistance of the Ministry of Transport. Under the Locomotives Acts and the Heavy Motor Car Orders, owners of weak bridges can prohibit locomotives and motor cars above a certain weight to use them. There has been a growing volume of complaint, particularly in the Midlands, regarding the loss and inconvenience to trade and industry caused by the existence of these weak links in the country's highway system. At present, however, the Minister of Transport has no power to compel the reconstruction or improvement of a weak bridge, even on a highway of first-class importance. The Bill presented last week is designed to enable highway authorities and the owners of bridges to effect arrangements with regard to the improvement or reconstruction of bridges and approaches without the necessity for specific sanction in every case. Either the owner or the highway authority, if a bridge was considered unsuitable for the requirements of road traffic, may apply to the Minister of Transport for an order for its reconstruction or improvement. The cost of the work, so far as the owner is concerned, will be limited to his capitalised annual cost of maintenance of the bridge.

Rural Electrification.

THE supply of electricity in rural areas is a feature of the eighth annual report of the Electricity Commissioners, referred to elsewhere in this issue. The cost of distribution, including capital charges, the report states, is second only in importance to the cost of generation as a factor in determining the ultimate prices at which electricity can be supplied to consumers, and much scope for economy in distribution by technical and other means undoubtedly exists. In the past there has been little or no commercial incentive to embark upon the extension of electrification in rural areas, owing to the great disparity in the distribution and density of population as between urban and rural areas. It is apparent, the report goes on to state, that the provision of an electrical service for small communities and individual farms in wide areas of low population density presents problems differing in many respects from those of urban areas. Generally speaking, the potential load is much sparser, the distances to be covered are greater, and the spending capacity of the rural population is on a lower scale than in urban areas. But the results already attained by a number of undertakers operating outwardly from urban centres go to show that a considerable amount of rural electrification is economically possible in cases where the rural load can be developed as a supplement to an urban load. Further experience is, however, necessary before it can be determined whether the electrification of a wide rural area can be successful without an urban load as a nucleus.

The London Power Company.

No. II.*

THE BOW GENERATING STATION.

THE Bow station lies on the north-east of the territory served by the London Power Company. It was originally built in 1900 by the Charing Cross Company to supply the City and Strand districts of London, and was rightly regarded at that time as one of the most efficient stations in the kingdom, noteworthy alike for the size of its units and the economy of its operation. The generators were driven by slow-speed vertical Sulzer engines of 8000 H.P., and the boiler-room contained the largest boilers then existing in the world. The first boilers to be installed were of the horizontal water-tube type, with 8100 square feet heating surface, but as early as 1903 Mr. W. H. Patchell, the engineer to the company at the time, put down a Hornsby boiler, with no less than 21,700ft. of heating surface, and an hourly evaporation of 100,000 lb. of water. This boiler was fired by two chain grate stokers set at right angles.

Some time before the war the directors had determined that the Bow station should be modernised, but before the work could be commenced the war intervened, and it was not until 1919 that the scheme prepared could be effectively undertaken. In order to appreciate the transformation that has been accomplished it is necessary to consider the state of affairs in 1919. At that time the station contained reciprocating machinery only, of an aggregate capacity of 24,000 kW. The steam pressure was 175 lb. per square inch at a temperature of 440 deg. Fah., and the boiler-house had none of the instruments now regarded as essential to efficient operation. The coal consumption for the year 1919 was 89,355 tons for a total output of 42,521,950 kWh, or a consumption of 4·7 lb. per unit generated. During 1927 63,908 tons of coal were burnt for an output of 79,111,000 kWh, or 1·81 lb. per unit, an improvement of no less than 61·5 per cent. in fuel consumption.

It was determined that the new plant should be installed without extending the existing buildings, and a commencement was made by putting down two 6000-kW turbo-alternators at the end of the engine-room, which could be done without materially affecting the existing machinery. These machines were designed to take steam at 270 lb. per square inch, and at a temperature of 650 deg. Fah., as it was decided to adopt these steam conditions for the reconstructed station, in place of the 175 lb. and 440 deg. previously employed. This decision, of course, involved the replacement of the whole of the existing boilers, which was carried out step by step as opportunity occurred and as machinery to use steam at the higher pressure was installed. The steam-raising plant now consists of thirteen boilers, of which eleven are of the Babcock and Wilcox C.T.M. type, and two of Vickers-Spearing design. The first nine of the boilers have each a maximum steaming capacity of 70,000 lb. per hour, and the last four a maximum capacity of 83,000 lb. per hour. These four are equipped with air heaters, raising the temperature of the air for combustion to 320 deg. Fah. All boilers are fitted with chain grate stokers. Each boiler has its own superheater and economiser, and in accordance with modern practice, it has also its own steel stack with forced and induced draught fans. In addition, every stack is provided with a Davidson grit collector. On every chain grate is a Lea coal meter, the readings of which are found to give an accurate record of the coal burnt. Each boiler, moreover, is equipped with a full set of instruments necessary for its proper operation; indicators and recorders being provided for CO_2, for steam flow, and for steam temperature, while other indicators also enable the temperature of the feed water and the flue gases to be kept continually under observation. It will thus be evident that the boiler house has been thoroughly modernised, with the result that an overall efficiency of about 80 per cent. is steadily maintained.

Turning now to the engine-room, at the same time as the boiler-house was being reorganised, the old

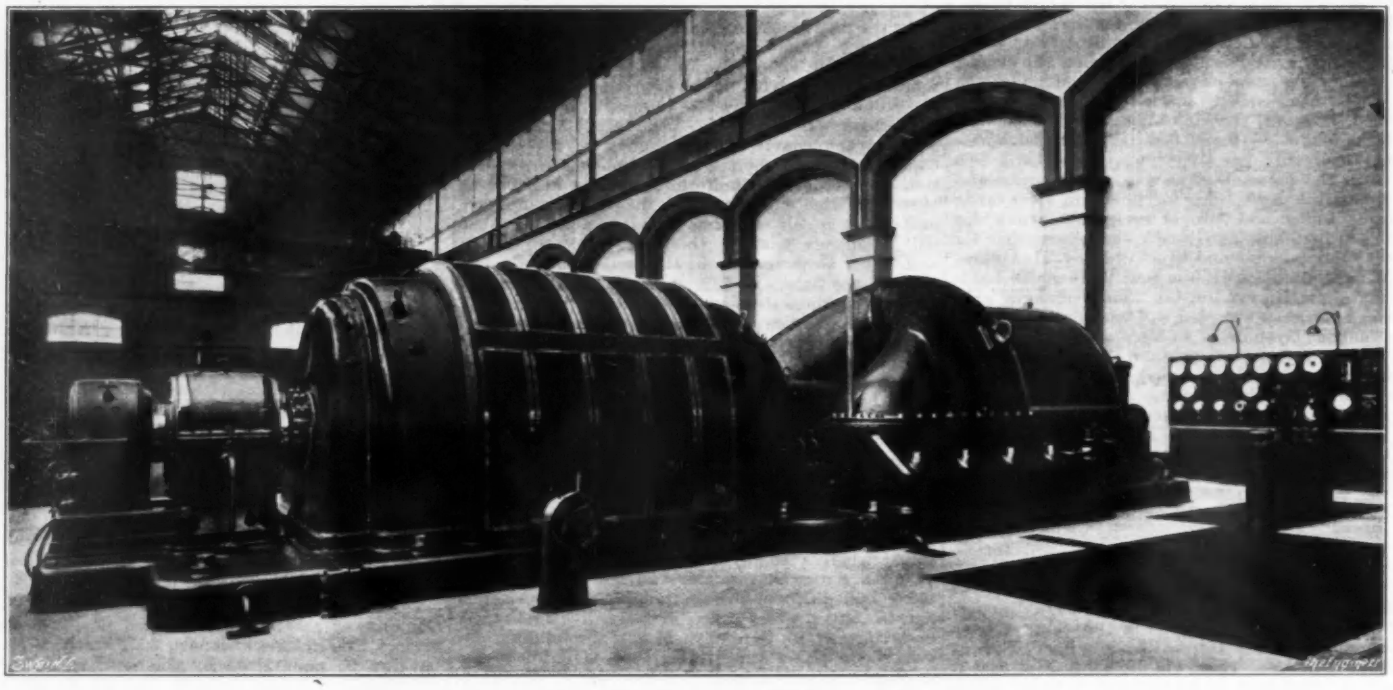

FIG. 3—BOW GENERATING STATION. INTERIOR OF ENGINE-ROOM

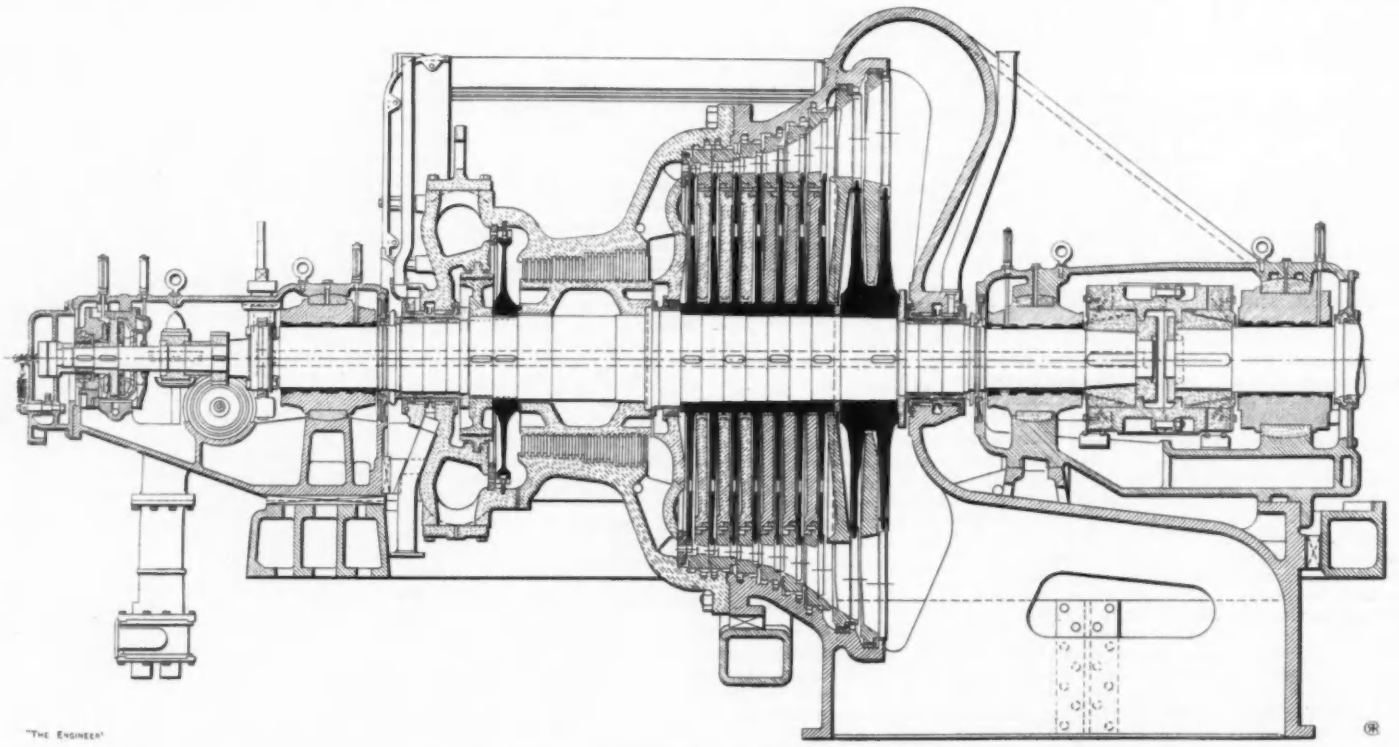

FIG. 4—18,750 kW GENERAL ELECTRIC STEAM TURBINE

* No. I. appeared February 15th.

reciprocating engines and alternators were removed one by one and replaced by turbine machinery. The engine-room now contains six turbo-alternators, of an aggregate capacity of 74,250-kW maximum continuous rating. They comprise, in addition to the two 6000-kW sets mentioned above, two machines, each of 13,750 kW, one of 16,000 kW and one of 18,750 kW capacity. It may be mentioned that the 74,250 kW of turbine machinery occupies considerably less space than the 24,000 kW of reciprocating machinery which it displaced, and gives, moreover, a vastly better lighted and more easily supervised engine-room. The effect of the new plant began to make itself felt as soon as the first units were available for service, the operating results becoming considerably better towards the end of 1923. For the year 1924 the coal consumption was 2·26 lb. per kWh generated, and the corresponding overall thermal efficiency of the station was 15·6 per cent., these figures being a great improvement on anything previously achieved. After that date progress was steady, as the following table will show :—

TABLE II.—*Bow Station, Thermal Efficiency.*

Year.	Pounds coal per kWh generated.	Thermal efficiency.
1924	2·26	15·6
1925	1·99	16·3
1926	1·95	17·26
1927	1·81	17·46
1928*	1·68	19·0

* First six months of year only.

These figures are sufficient to show that the efficiency of the Bow station has been raised once more to a figure which will compare already with that of some of the largest and most recent of the central stations in the kingdom, and there is no sign that the limit has been reached.

A view of the engine-room, taken specially to show in the foreground the appearance of the latest generating set to be installed, is reproduced in Fig. 3. This machine, constructed by the General Electric Company —the turbine being built at its Fraser and Chalmers works at Erith, and the generator at its Witton works—is the largest unit in the Bow station. It has a maximum continuous rated capacity of 18,750 kW at 0·8 power factor, and delivers three-phase current at 50 cycles and 11,000 volts. The speed of the set is 1500 revolutions per minute. The turbine, a longitudinal section of which is given in Fig. 4, is of a rather unusual construction, but the design is amply justified by the results obtained. The steam

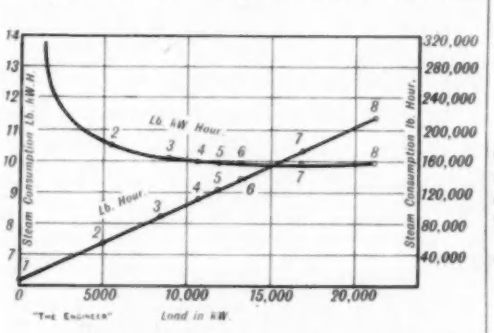

FIG. 5 TURBINE TEST CURVES

acts first on a velocity compounded wheel, and then through twenty of what may be called low-velocity impulse stages mounted on a drum. It then enters the low-pressure part of the turbine in which are nine impulse wheels separated by diaphragms in the usual way. The turbine has therefore thirty pressure stages in all, and combines in one cylinder the essential features of the latest two-cylinder machines. The mean blade speed of the first wheel is about 349ft. per second, that of the drum blading about 242ft. per second, and that of the last wheel about 623ft. per second. Cast steel is employed for the whole of the casing, except the short length surrounding the last six wheels where both temperatures and pressures are very low. Even the first three diaphragms in the low-pressure end are of cast steel and the same material is used for the drum carrying the low-speed impulse stages, and for the dummy piston which counterbalances the end thrust due to the drum. Any residual end thrust which may exist is taken care of by a double thrust block on the Michel principle housed in the high-pressure pedestal. The length of the turbine between centres of bearings is only 12ft. 5½in., and to accommodate thirty stages developing 18,750kW in this length gives a machine with a performance comparing favourably with that of many multi-cylinder turbines, with all the advantages of a single casing. In the design of the nozzles and blading, the results of the research work of the Steam Nozzles Committee of the Institution of Mechanical Engineers have been fully utilised, and the care expended on details is shown by the provision of effective circumferential drainage to keep the steam as dry as possible at every stage of the low-pressure part of the machine.

Fig. 5 is a diagram giving the test results of the turbine obtained in March, 1928. Eight tests in all were made. They ranged from no load to 21,450 kW, or an overload of about 14½ per cent. The most economical load was at about 16,850 kW, when the steam consumption was only 9·825 lb. per kWh. The whole of the seven tests up to and including that point fell, when plotted, upon a perfectly straight line, with an equation

$$S = 6000 + 9{\cdot}436\,K,$$

in which S represents the total steam consumption per hour, and K the load on the machine. The smallness of the no-load consumption of 6000 lb. per hour only, will be noticed. This causes the efficiency curve to be particularly flat, so that low loads are carried with economy. With only 5100 kilowatts on the machine, the steam consumption did not exceed 10·6 lb. per kWh. The figures for the whole of the eight tests are given in the Table III. below.

TABLE III.—*Tests of 18,750-kW Fraser and Chalmers' Turbine at Bow.*

Test No.	Load in kW.	Steam, lb. per kWh.
1	0	—
2	5,100	10·60
3	8,550	10·15
4	10,500	10·00
5	12,000	9·925
6	13,150	9·90
7	16,850	9·825
8	21,450	9·925

The steam pressure at the stop valve was 250 lb. per square inch, with a temperature of 650 deg. Fah.

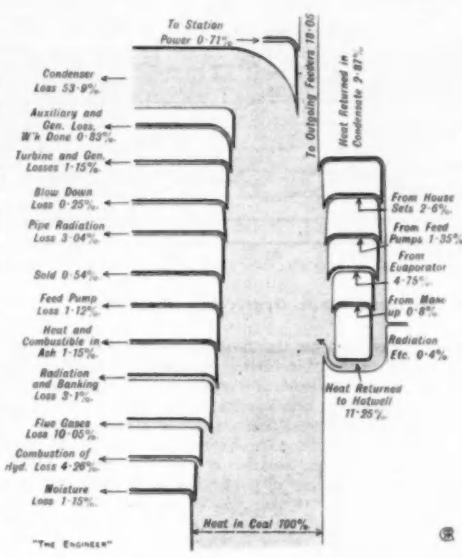
To Station Power 0·71%
To Outgoing Feeders 18·05%
Heat Returned in Condensate 2·87%
Condenser Loss 53·9%
Auxiliary and Gen. Loss. W'k Done 0·83%
Turbine and Gen. Losses 1·15%
Blow Down Loss 0·25%
Pipe Radiation Loss 3·04%
Sold 0·54%
Feed Pump Loss 1·12%
Heat and Combustible in Ash 1·15%
Radiation and Banking Loss 3·1%
Flue Gases Loss 10·05%
Combustion of Hyd. Loss 4·26%
Moisture Loss 1·15%
From House Sets 2·6%
From Feed Pumps 1·35%
From Evaporator 4·75%
From Make up 0·8%
Radiation Etc. 0·4%
Heat Returned to Hotwell 11·25%
Heat in Coal 100%
"The Engineer"

FIG. 6—HEAT FLOW DIAGRAM

The circulating water was maintained constant, so that the vacuum varied with the load, the absolute condenser pressure being 1in. mercury when the machine was carrying 80 per cent. of its rated load.

Bow was originally a cooling tower station, but the original towers put down to serve the reciprocating plant became totally inadequate as soon as turbine machinery was installed. A new set of towers capable of cooling one million gallons of circulating water per hour was therefore erected Space did not permit of the erection of further towers, so the solution of the condensing water problem had to be sought elsewhere. There was running past the station, a little creek known as the Pudding Mill River, which flowed, when it flowed at all, into the river Lea. It entered the Lea just below the last lock and therefore rose and fell according to the tides in the Thames. Permission was obtained to remove the lock gates on the Lea a little bit further down, below the outlet of the creek and to put a dam across the creek at a point opposite the power station. This had the effect of impounding the water of the Lea in the creek at a constant level independently of the tides. The first stage of this work provided two million gallons per hour of circulating water for the station, and extensions now in hand will render sufficient water available for the maximum needs of the plant. It may be mentioned that, when the Lea water was first used, considerable trouble was experienced with the condensers, the tubes of which quickly became covered with a slimy algal growth which necessitated continual cleaning of condensers if the vacuum was to be maintained. The

TABLE IV.—*London Power Company, Ltd., Bow Generating Station.—Heat Balance Statement for the Week Ending May 2nd, 1928.*

The figures are based upon the average of one hour of the week.

	lb.	B.Th.U.
B.Th.U. at inlet of boilers—		
From coal	18,866	195,187,636
From feed water	130,400	21,907,200
		217,094,836
B.Th.U. leaving boilers—		
Steam	130,400	177,996,000
In ash, chimneys, radiation, &c.	—	39,098,836
		217,094,836
Steam main—		
Steam to main turbine	111,290	149,685,050
Steam to evaporators	6,912	9,296,640
Steam to auxiliary turbine	5,078	6,713,116
Steam to feed and L.L. pumps	3,585	4,821,825
Steam to local factory	780	1,049,100
Blow-down and leakages	2,755	495,900
Heat lost in pipe friction, drains, blow-downs, leakages, &c.	—	5,934,369
	130,400	177,996,000
Main turbine—		
B.Th.U. to condenser		105,169,050
B.Th.U. to switchboard		36,641,468
Condensate		5,631,274
Heat lost in turbine, &c.		2,243,258
		149,685,050
Auxiliary turbine—		
B.Th.U. to station bus-bars		487,916
B.Th.U. to hotwell		5,078,000
Heat lost in turbine		1,147,200
		6,713,116
Feed and L.L. pumps—		
Exhaust		2,628,380
Heat lost and work done		2,193,445
		4,821,825
B.Th.U. returned to hotwell—		
From main turbine		5,631,274
From auxiliary turbine		5,078,000
		10,709,274
Temperature of water in hotwell = 92 deg. + 32 deg. = 124 deg. Fah.		
B.Th.U. returned to head tank—		
From hotwell		10,709,274
From feed pumps		2,628,380
From evaporators		9,296,640
From make-up		161,728
		22,796,022
Temperature of water in head tank = 174 deg. + 32 deg. = 206 deg. Fah.		
B.Th.U. returned to economiser from head tank—		
From head tank		22,796,022
Heat lost in friction, leakages, &c.		888,822
Net B.Th.U. to economisers		21,907,200
Final temperature of water = 168 deg. + 32 deg. = 200 deg. Fah.		

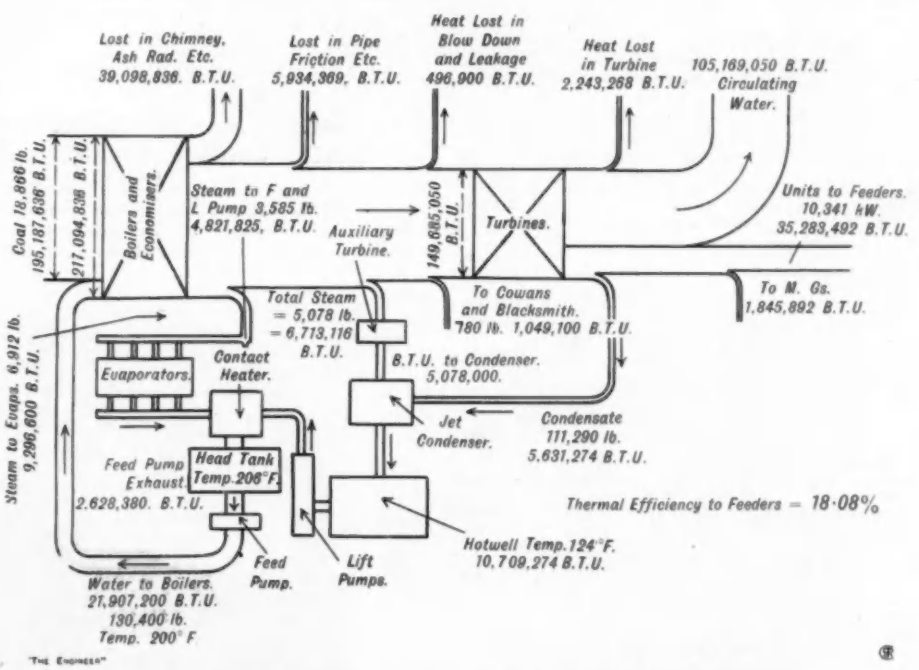
Lost in Chimney, Ash Rad. Etc. 39,098,836. B.T.U.
Lost in Pipe Friction Etc. 5,934,369. B.T.U.
Heat Lost in Blow Down and Leakage 496,900 B.T.U.
Heat Lost in Turbine 2,243,268 B.T.U.
105,169,050 B.T.U. Circulating Water.
Coal 18,866 lb. 195,187,636 B.T.U.
217,094,836 B.T.U.
Boilers and Economisers.
Steam to F and L Pump 3,585 lb. 4,821,825, B.T.U.
Auxiliary Turbine.
149,685,050 B.T.U.
Turbines.
Units to Feeders. 10,341 kW. 35,283,492 B.T.U.
To M. Gs. 1,845,892 B.T.U.
Total Steam = 5,078 lb. = 6,713,116 B.T.U.
To Cowans and Blacksmith. 780 lb. 1,049,100 B.T.U.
B.T.U. to Condenser. 5,078,000.
Steam to Evaps. 6,912 lb. 9,296,600 B.T.U.
Evaporators.
Contact Heater.
Jet Condenser.
Condensate 111,290 lb. 5,631,274 B.T.U.
Feed Pump Exhaust 2,628,380. B.T.U.
Head Tank Temp. 206° F.
Thermal Efficiency to Feeders = 18·08%
Hotwell Temp. 124° F. 10,709,274 B.T.U.
Feed Pump.
Lift Pumps.
Water to Boilers. 21,907,200 B.T.U. 130,400 lb. Temp. 200° F
"The Engineer"

FIG. 7—DIAGRAM ILLUSTRATING HEAT BALANCE STATEMENTS

difficulty was overcome by the use of chlorine, fed automatically into the circulating water in the proportion of six parts of chlorine to a million parts of water, by a Paterson chlorinator. The chlorine had the effect of sterilising the water, thereby preventing the algal growth and of almost doing away with condenser cleaning and loss of vacuum by dirty tubes.

The main turbines are not bled for the purpose of heating the feed water, but a partially regenerative thermal cycle is obtained by the use of house sets. There is a pair of 1000-kW geared turbines driving continuous current generators and supplying power for the purposes of the station. These units are fitted with jet condensers. The whole of the condensate from the main turbines is used as injection water for the condensers of the house turbines, which has the effect of raising its temperature to approximately 150 deg. Fah. This water is then used to condense the vapour from the evaporators. It is then deaerated and finally discharged into the suction tanks of the high-pressure feed pumps. These latter are of the Weir turbine type and the exhaust from their turbines provides the heat for evaporating the make-up water. Live steam is also available for this purpose, should the exhaust be inadequate at any time.

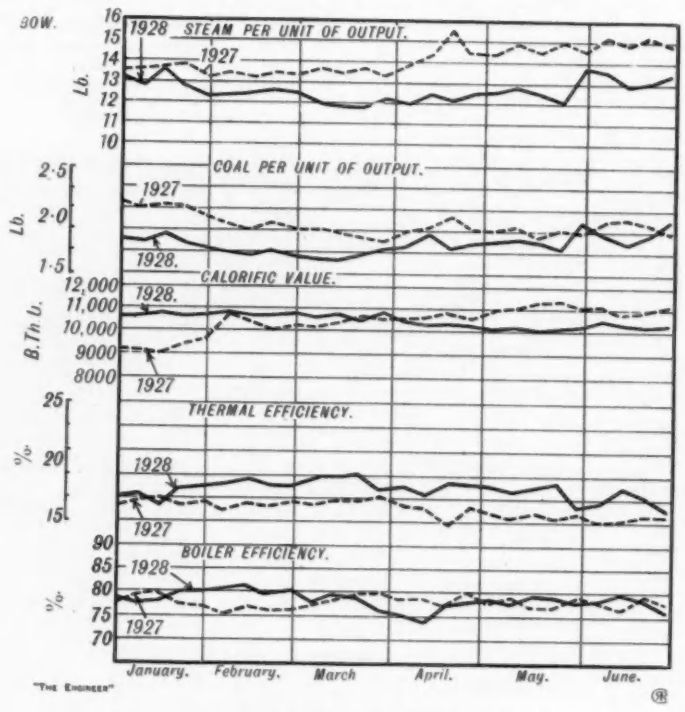

FIG. 8—CURVES SHOWING MAIN OPERATING RESULTS

The load on the house turbines is adjusted so as to maintain the temperature of the feed water at its desired value. Temperature indicators are provided on the switch gallery, and demands for more power than that which can be usefully provided by the house turbines at any time are taken care of by two 1000-kW motor generators which are operated in parallel with the house turbines.

A Sankey heat-flow diagram showing the final distribution of the heat in the fuel burnt during the week ending May 2nd, 1928, is reproduced in Fig. 6. It is based, as will be observed, on the higher calorific value of the coal, and shows that 18·06 per cent. of the gross heat value of the coal as fired is available as electricity on the feeders. A small amount of steam is sold to a factory near the station, and if the heat disposed of in that way is deducted from the heat in the fuel burnt, which it is certainly legitimate to do, the thermal efficiency from coal to feeders is 18·15 per cent. There are, we believe, stations for which the thermal efficiencies are still returned on the basis of the lower calorific value of the coal, and on the gross amount of power generated. If the Bow figures were put on that basis the thermal efficiency would work out to no less than 19·7 per cent. for the week in question.

Tables IV. and V. show the performance of the station, in numerical form, for the same week, the figures being reduced to represent an average hour's operation. From the first of these tables it can readily be deduced, among other facts, that the average boiler efficiency was 81·9 per cent. and the turbo-generator efficiency 24·5 per cent. The second table presents the main items in the form of a balance sheet, the heat units which have to be accounted for appearing on the side of "Liabilities" and the means of their disposal appearing on the "Asset" side of the account. The diagram Fig. 7 shows graphically the facts set out in Tables IV. and V. with the further advantage that it illustrates the heat cycle of the station. Finally, we give in Fig. 8 the main operating results for the first six months of the years 1927–1928 in graphic form. A marked improvement will be noticed in both the coal consumption per unit and in the steam consumption per unit. The boiler efficiency for the two periods is not greatly different, so that the change for the better has been principally in the engine-room, and is no doubt largely attributable to the putting into service of the Fraser and Chalmers turbine which we have described above. In reflecting upon the enormous improvement which has been brought about in the efficiency of the Bow station during the past few years it should be remembered that during the whole of the reorganisation period the full load had to be carried as usual. To replace every single boiler and every generating unit and to operate the station with two different boiler pressures for a long period while that was being done was a task of no small difficulty, as every central station engineer will recognise. However, it has been successfully accomplished, and Bow station has once again, as we have shown, taken its place amongst the most efficient and well-managed plants in the country.

(To be continued.)

TABLE V.—*London Power Company, Ltd., Bow Generating Station.—Heat Balance Statement for the Week Ending May 2nd, 1928.—Balance Sheet.*

Input.		B.Th.U.
By coal		195,187,636
By returned heat in feed		21,907,200
		217,094,836
Output.	**B.Th.U.**	**B.Th.U.**
Boilers—		
Chimney, radiation, ash, &c.		39,098,836
Steam main—		
Heat lost in pipe friction, radiation, blow-downs, leakages, &c.	6,430,269	
To Cowan's and blacksmith	1,049,100	
		7,479,369
Main turbine—		
Condenser	105,169,050	
Output to switchboard	36,641,468	
Condensate	5,631,274	
Lost in friction, radiation, &c.	2,243,258	
		149,685,050
Auxiliary turbine—		
To station bus-bars	487,916	
Returned to hotwell	5,078,000	
Lost in friction, radiation, &c.	1,147,200	
		6,713,116
Feed pumps—		
Exhaust	2,628,380	
Lost in friction and work done	2,193,445	
		4,821,825
Evaporators—		
To head tank		9,296,640
		217,094,836

The Salving of the ex-German Battle Cruiser Seydlitz.

WHEN, in our issue of June 1st, 1928, we described and illustrated the successful salving of the battle-cruiser "Moltke" and her towage to Rosyth Dockyard, we had occasion to refer briefly to the work then going on at Scapa Flow in connection with the raising of the sister ship, the "Seydlitz." Cox and Danks, Ltd., began operations on this ship in June, 1927, and work on her was continued throughout the winter of that year. When we visited Scapa Flow during the summer of 1928, work was well advanced on the "Seydlitz," and hopes were then entertained of lifting the ship as she lay, namely, on her side, in 72ft. of water. Subsequent events, however, necessitated the adoption of a different plan, and towards the end of October last year, the "Seydlitz" was floated upside down, and on November 2nd, 1928, she was towed a distance of nearly four miles to the firm's depot at Lyness Pier, where she now lies in about 46ft. of water. Since that time the main work done on the hull has been in the direction of lightening the weight, and, at the same time, strengthening the bulkheads and patches so that the final operation of towing her upside down to Rosyth may be safely undertaken either in April or May. In what follows a short description of the ship and the means employed to float her are given.

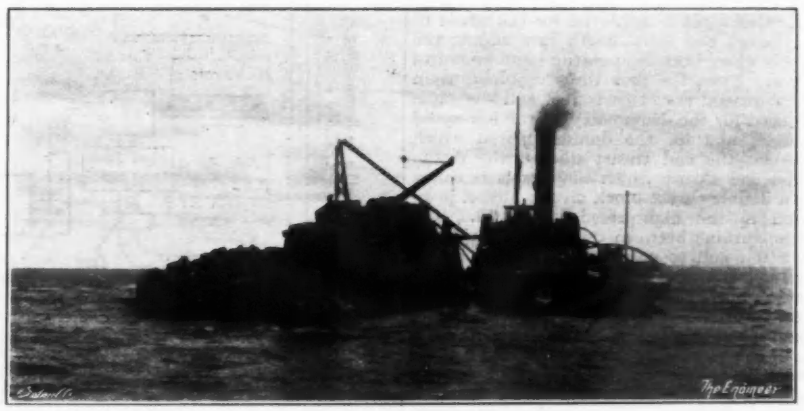

FIG. 1—VESSEL WITH EXTERNAL ARMOUR REMOVED

The battle-cruiser "Seydlitz," which was scuttled at her anchorage in Scapa Flow on June 21st, 1919, presented the most difficult salvage task yet undertaken by Cox and Danks, Ltd., on account of her having sunk on her side—as shown in Fig. 4. She was built and engined by Blohm and Voss, of Hamburg, and finished her trials during the summer of 1913. She has a length of about 656ft. at the waterline, with a beam of 93·3ft. Her propelling machinery comprised a four-screw arrangement of Parsons turbines designed for a total output of about 63,000 S.H.P., corresponding to a speed of about 26·5 knots. Twenty-seven Schulz-Thornycroft type water-tube boilers were accommodated in two boiler-rooms, and very large bunker spaces for both coal and oil were provided. As regards her armour, the "Seydlitz" was generally similar to the "Moltke," but the armouring was carried a little higher at the forward part of the ship. The view given on Fig. 4 clearly shows a part of the main armour belt towards the bow of the ship, while amidships this armour has a thickness close upon 12in. It has a depth of nearly 18ft., and is applied to the hull in vertical sections which are reduced in thickness on the upper and lower edges.

When it was first planned to raise the ship she was on her side, as indicated in "Position 1," shown in Fig. 5. In order to lighten the hull generally, and to balance the righting forces, it was considered advisable to take off part of the main armour and such outside plates as were accessible at low tide. The earlier and later stages in the work are indicated in Figs. 4 and 1. In all, a quantity of over 1800 tons of steel was removed in this way, and was transported by means of tugs and pontoons to Lyness, for cutting up and despatch. When the outer shell and armour had been cut away, a new top-side was formed by the 2in. thick inner armour, which was designed to protect the machinery and boiler spaces. On this new flat deck machinery houses and shelters were erected, and eight air locks, about 6ft. in diameter and 6ft. high, were put in position. The jib cranes—shown in Figs. 1 and 4—were utilised for lifting off the steel plates and for the erection of the new airlocks. Part of the air compressing plant was arranged aboard, and other supplies were taken from the tugs in attendance. It was found possible to divide the hull in the way of the machinery and boiler spaces, a distance of some 268ft. in length, into six convenient compartments, which, together with the forward and after spaces in the ship, gave eight different and independent sections. By working on one section at a time under air at pressures varying between 10 lb. to 20 lb., all the openings on the main deck and side of the ship, together with vents leading to the funnels, were sealed off and made airtight. We had the interesting experience of examining some of the engine and boiler spaces when they were under air pressure, and we were able to see for ourselves that the work of making good within the airtight compartments had been carried out successfully to depths up to 6ft. below the centre line of the ship. A great deal of the sealing off was done with "Ciment Fondu," with suitable reinforcements of wood and metal where necessary. This material, we were informed, proved itself very useful on account of its quick hardening properties. The largest patch made was for the funnel opening, and measured 46ft. in length, with a depth of 28ft. and a thickness of about 12in. Such work was of necessity slow, as much burning away of obstructions had to be done before the sealing up process could be begun. Towards the end of February, 1928, the stern end of the ship began to move under air pressure, thereby indicating that the hull was becoming buoyant at that particular section. The operations on this part of the ship having been completed, the air was blown out of the three astern compartments so that the ship still kept the bottom and allowed work to proceed comfortably and safely in the other sections forward. Good progress was made during the spring months of 1928, but in June of that year, when the salvage engineers were trying to balance the air pressure in the

THE BRITISH INDUSTRIES FAIR

SOME OF THE EXHIBITS AT BIRMINGHAM

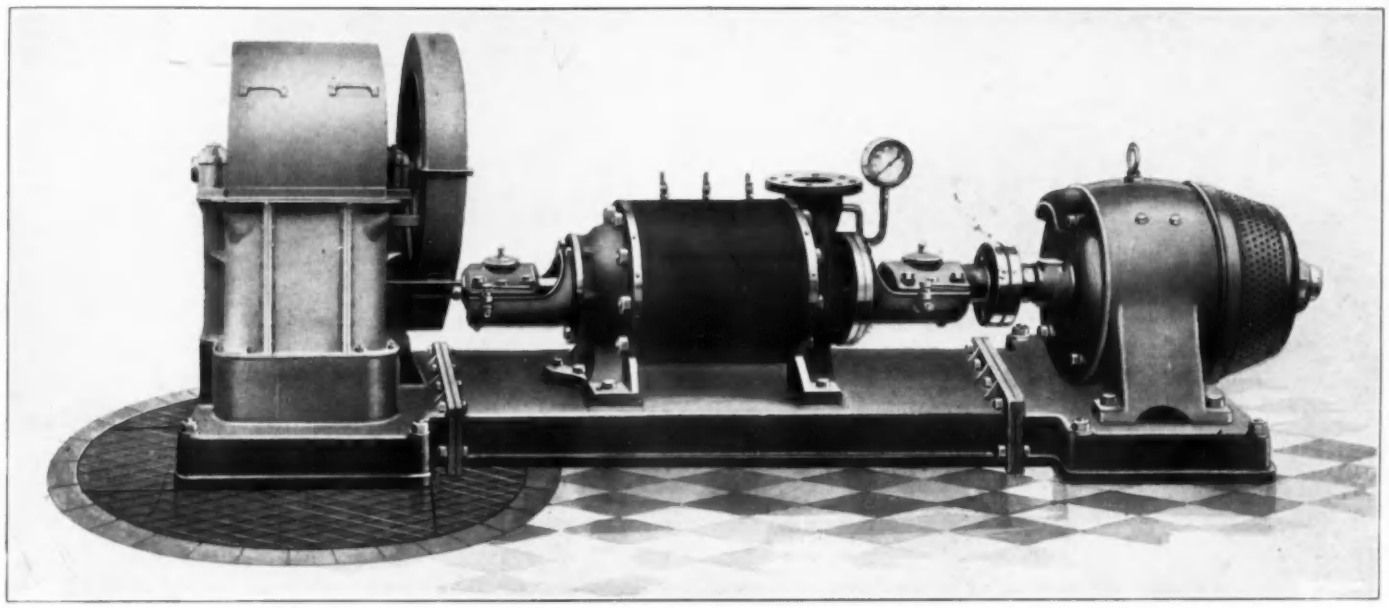

Fig. I. Combined Water Elevator and Pump Boulton and Paul

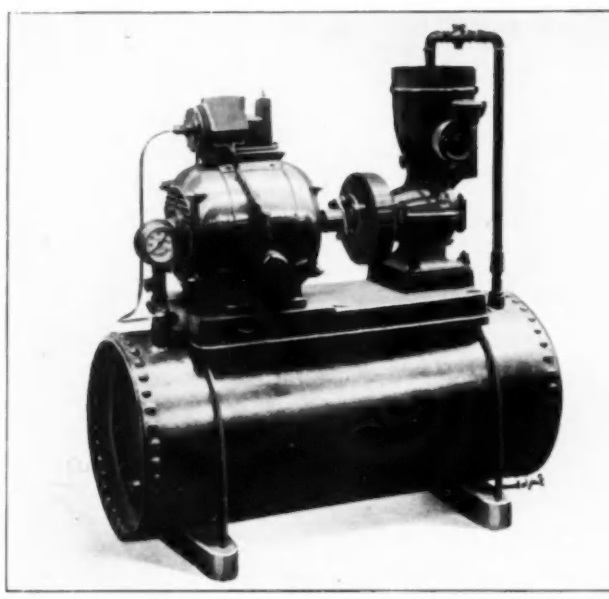

Fig. II. Air Compressing Set Lacy-Hulbert

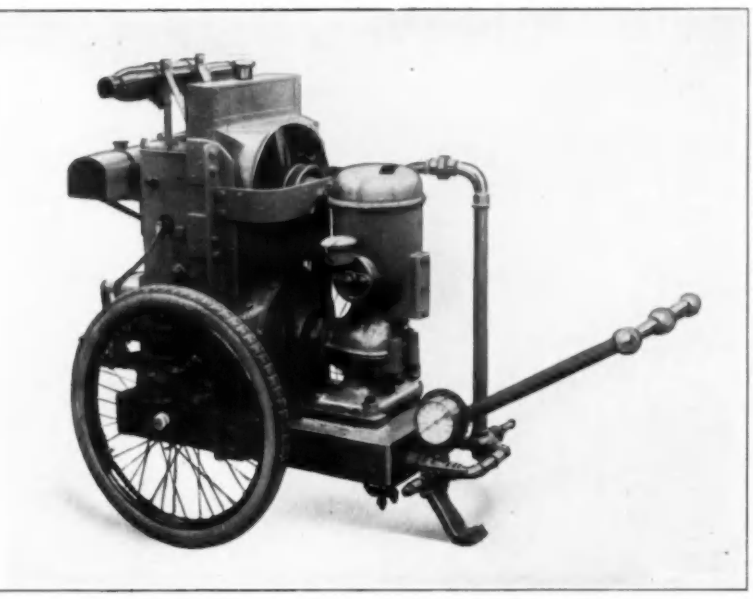

Fig. III. Portable Air Compressor Lacy-Hulbert

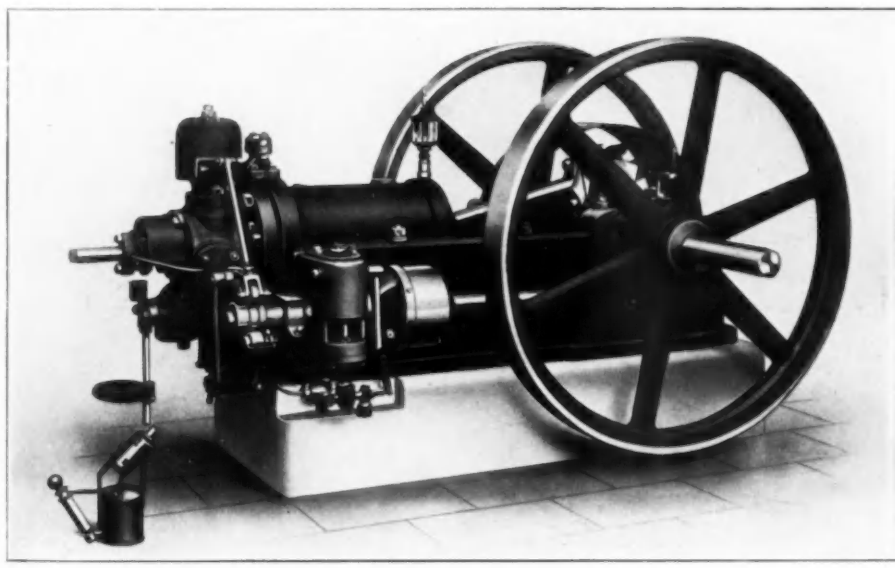

Fig. IV. 6 H.P. Lamp-Starting Engine—Tangye

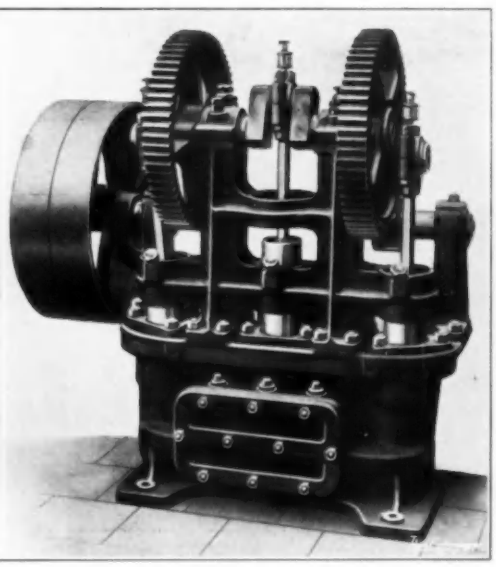

Fig. V. Treble Ram Pump Tangye

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SOME OF THE EXHIBITS AT BIRMINGHAM

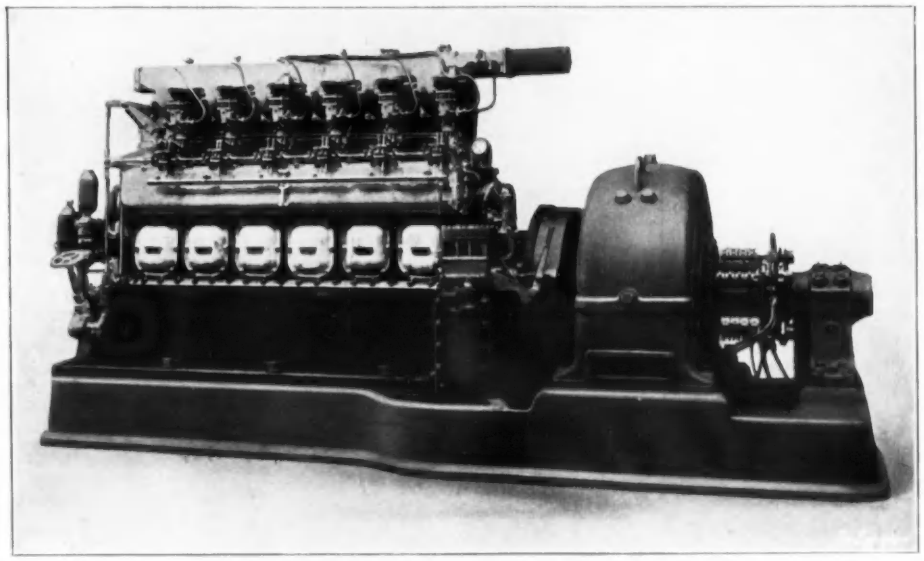

Fig. VI.—300 H.P. Oil Engine—Brotherhood

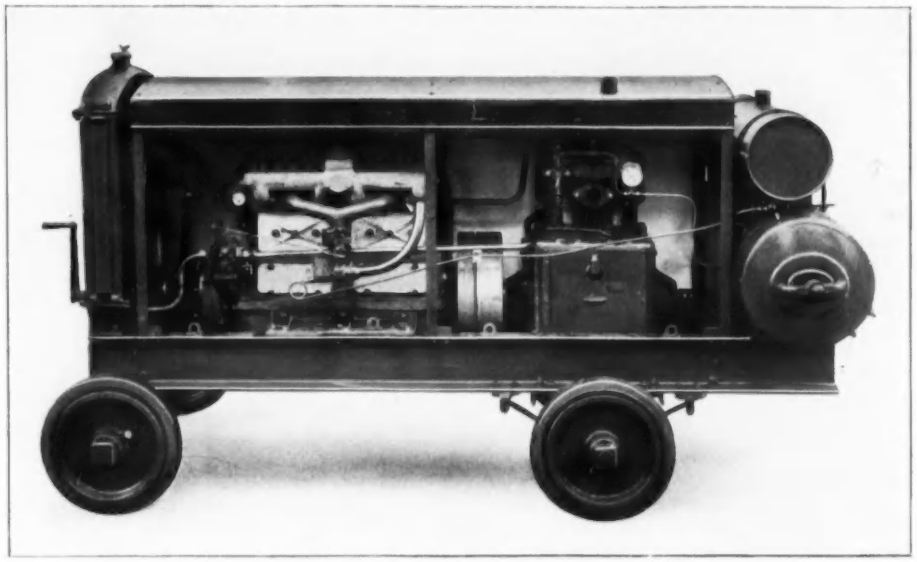

Fig. VII.—Portable Compressor Set—Broom and Wade

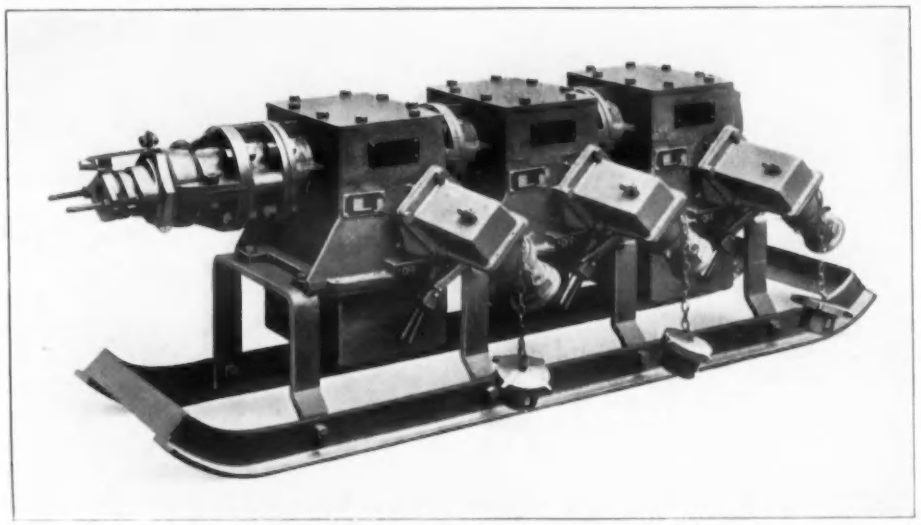

Fig. VIII.—"Mothergate" Switchgear—Reyrolle

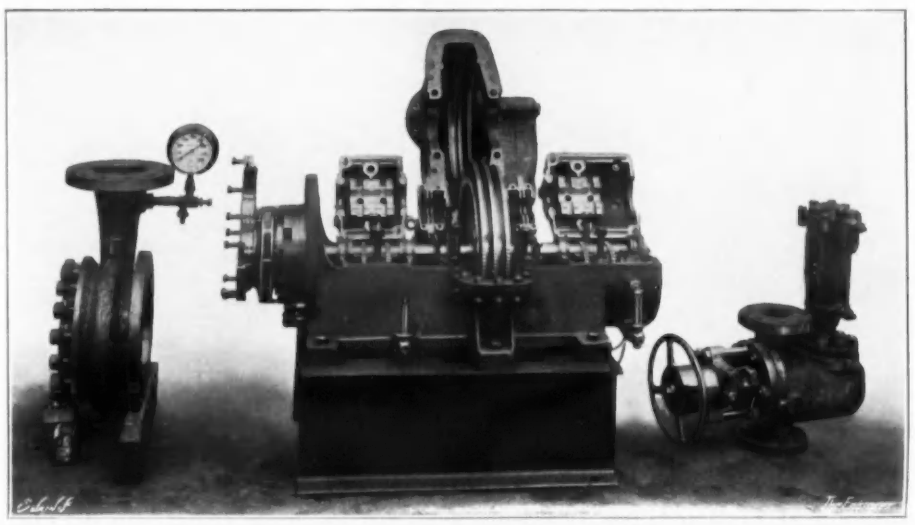

Fig. IX.—Turbo Feed Pump—Monel-Weir

FIG. VIII.—"MOTHERGATE" SWITCHGEAR REYROLLE

FIG. IX. TURBO FEED PUMP MONEL-WEIR

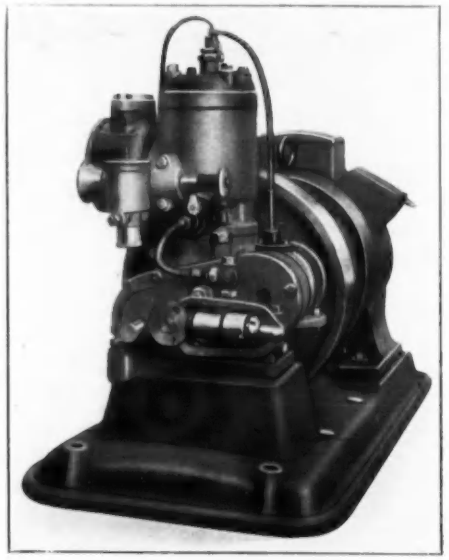

FIG. X.—½ kW LIGHTING SET—STUART TURNER

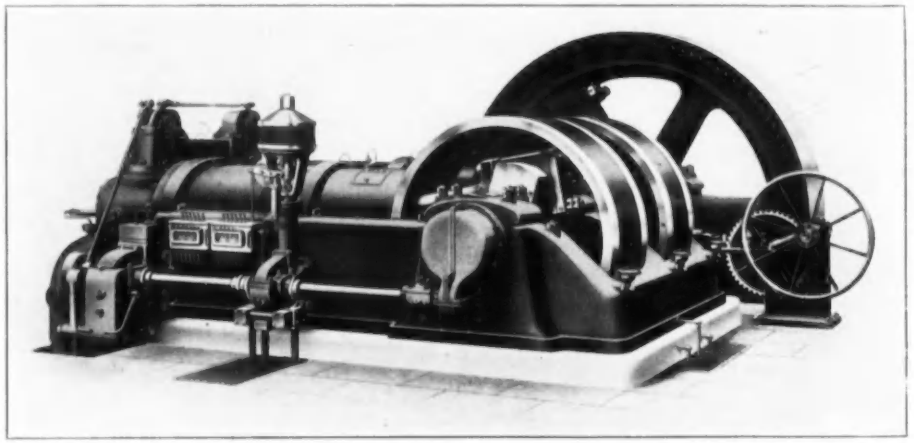

FIG. XI.—144 H.P. TWIN-CYLINDER OIL ENGINE—TANGYE

FIG. XII.—½ kW LIGHTING SET—STUART TURNER

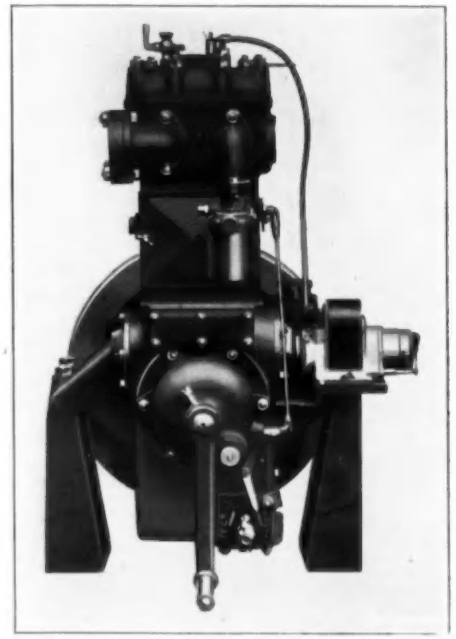

FIG. XIII.—4 H.P. OIL ENGINE—BOULTON AND PAUL

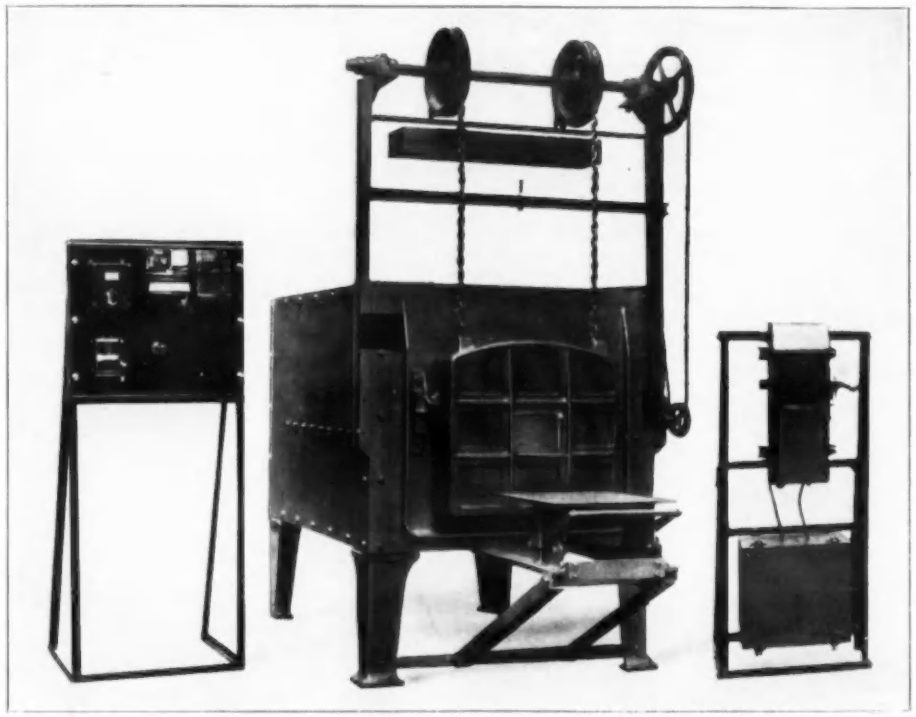

FIG. XIV.—30 kW ELECTRIC FURNACE AND CONTROL GEAR—G.E.C.

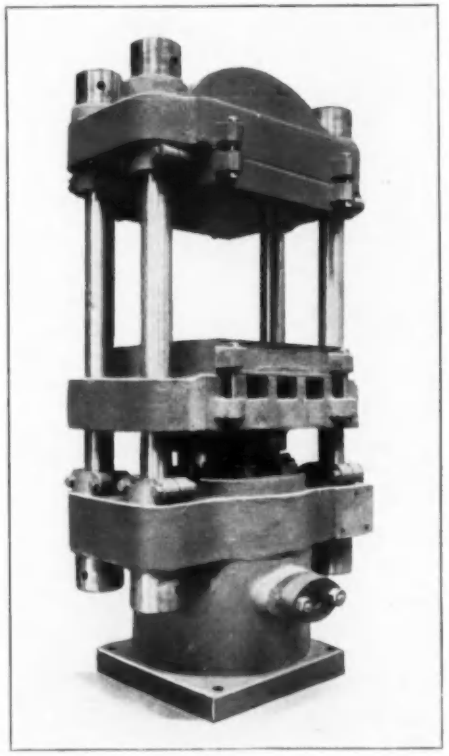

FIG. XV.—HOT-PLATE PRESS—HOLLINGS AND GUEST

THE BRITISH INDUSTRIES FAIR

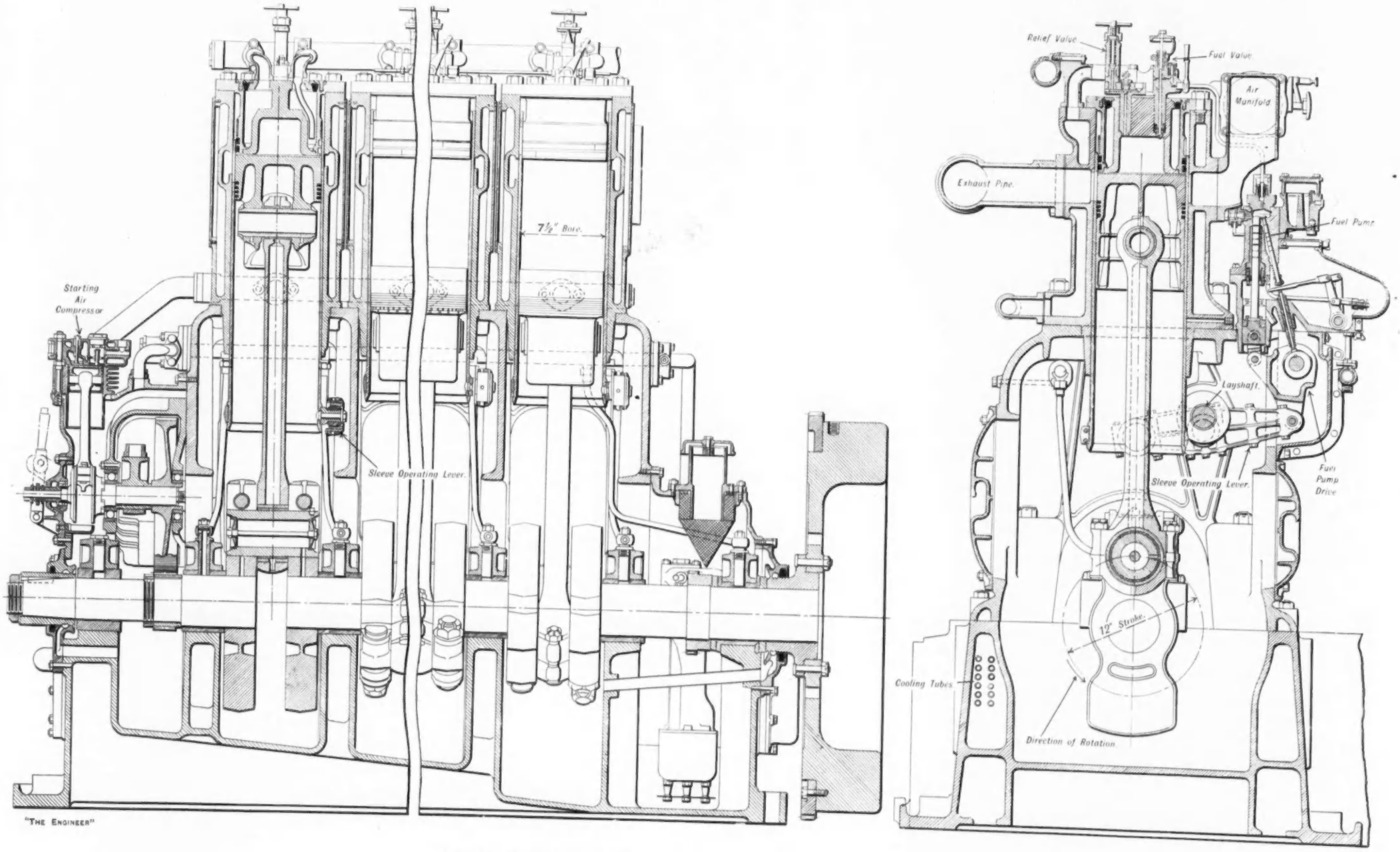

FIG. XVI. GENERAL ARRANGEMENT OF SLEEVE-VALVE OIL ENGINE—BROTHERHOOD

SALVING THE EX-GERMAN BATTLE CRUISER "SEYDLITZ"

COX AND DANKS, LTD., LONDON, ENGINEERS

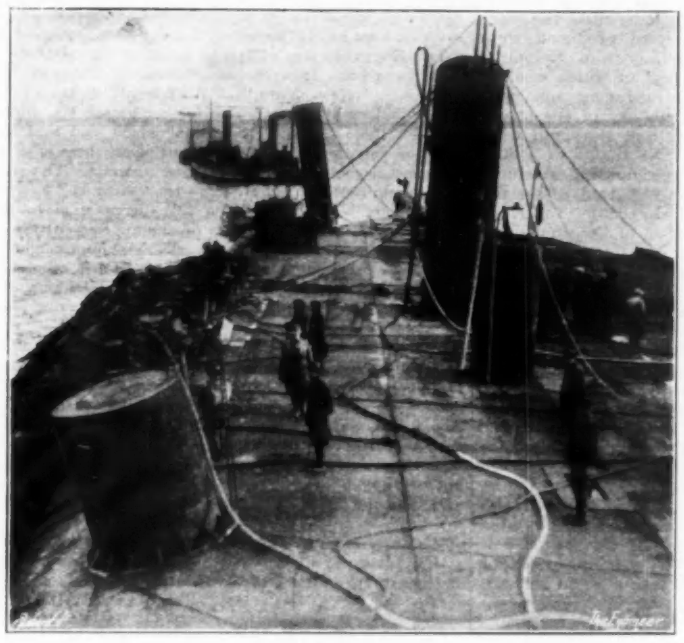

FIG. 2—THE VESSEL BEING TOWED TO LYNESS PIER

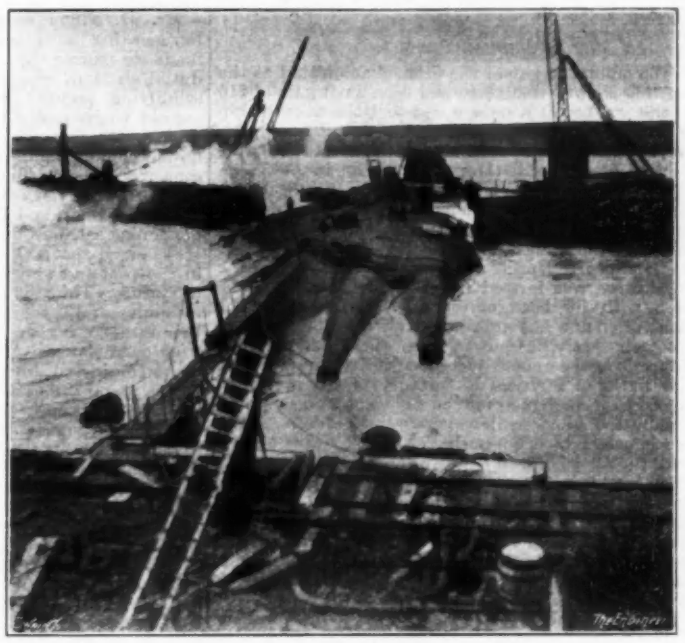

FIG. 3—THE VESSEL MOORED AT LYNESS PIER

eight different sections of the hull, in order, if possible, to lift the ship on an even keel, a large patch suddenly gave way, and made common three of the forward compartments. With this suddenly increased buoyancy in the forward part of the ship, the hull quickly turned over to an angle of 48 deg., and was only prevented from going right over by the two funnels and a mast which had been left in place.

The new position taken up by the ship is shown in Fig. 5, "Position 3." It will be seen that, of necessity, much of the work which had been successfully accomplished while the hull was in "Position 2" was at once destroyed. Owing to the crushing up of the bridge erections and the funnels, many of the wood and concrete patches, which had been carefully made on the main deck, were broken, and more than half of the airlocks were now under water at full tide, so that it was not possible to utilise them any further.

It became necessary to start work all over again, and to fit new and longer airlocks to the bottom of the ship, which was then uppermost. Again much of this work had to be carried out by divers, often in unfavourable weather. The problem presented at this stage of the operations was practically that of the "Moltke" over again, only that instead of a list of 17½ deg. a list of 48 deg. had to be reckoned with.

The new work was undertaken with alacrity, and no untoward experiences were met with till the actual lifting operations were begun.

Towards the end of October, when this part of the work was in progress, the ship, instead of righting herself on an even keel, went back again to an angle of 50 deg. Various measures were taken to bring the hull into a more level and manageable position. Two large floating docks were attached by heavy wire ropes to the ship, and at one stage a destroyer hull filled with water was lashed to the hull to give, if possible, a greater righting moment. The ship was partly lifted by compressed air and lowered again many times, and during these operations reinforced concrete supports were placed beneath her deck in order, if possible, to prevent the hull from taking up a more pronounced list. Finally, the measures taken proved to be successful, and it was eventually found possible to divide the upturned hull into six compartments, three athwartships in the way of the boiler-room, and the others fore and aft. By controlling the air pressure in these sealed spaces the hull was got under control to such an extent that by October 31st the ship only had a list of 25 deg., while on November 1st last she was raised upside down quite level, and was fully afloat the following day.

When the hulk was being floated the stern was still 20ft. under the water with the bow just awash, but the moment the hull became buoyant it jumped up nearly 20ft. and then commenced to turn again, going over to a list of 8 deg. The docks, however, steadied the hull by means of twenty-two 8in. and 9in. steel wires. These wires checked the list, but the stress was such that before doing so ten of the twenty-two wires were snapped.

By means of valves controlling the supply of air to the various sections the ship has been maintained in a level condition, and she has given no serious trouble since. The work of towing her to Lyness was handicapped owing to neap tide, and a halt was made about half-way at Gutter Sound to await a fuller tide. About seven days later the final stage of the five-mile journey was successfully accomplished. The whole of the towing operations were undertaken by the firm's own tugs, the "Sidonian," "Ferrodanks," and "Lyness."

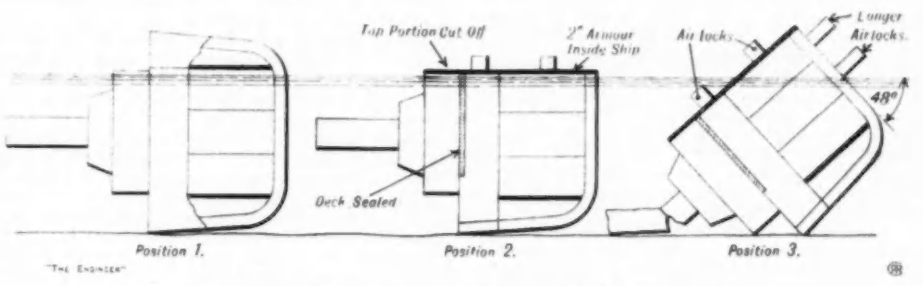

FIG. 5—DIAGRAM SHOWING STAGES IN SALVAGE OPERATIONS

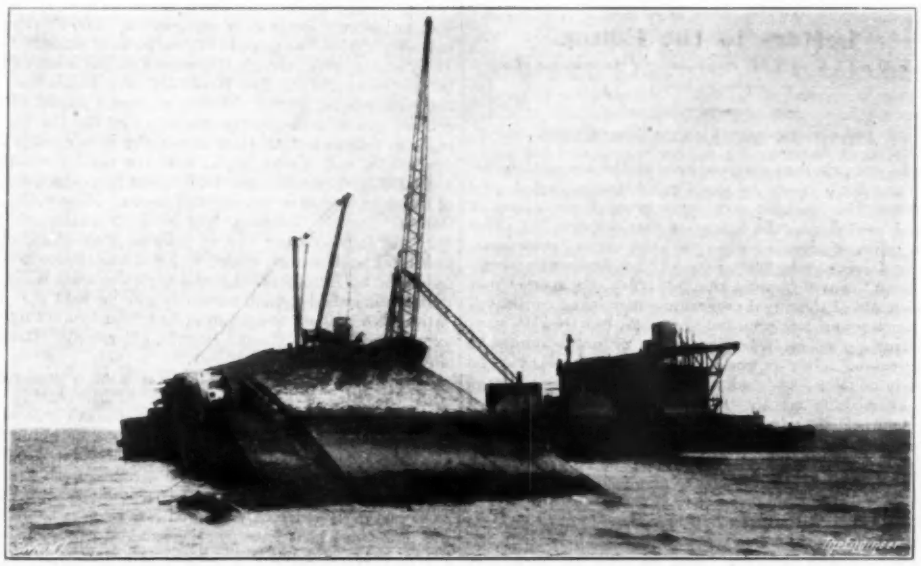

FIG. 4—DOCK IN POSITION FOR SALVAGE WORK

As shown in Fig. 3, the "Seydlitz" is now at Lyness Pier, but as she is drawing about 46ft. of water, the problem has been to lighten her sufficiently to enable her to be towed to Rosyth Dockyard and to enter the dry-dock there, which has only a depth of 40ft. over the sill. At the present time the forward turret, which, when cut a way, will be left on the bottom of the sea, and recovered after the ship has left, is being burnt off.

As regards salvage operations on the vessels which still remain to be lifted, it may be explained that work is now proceeding on the battleship "Kaiser," and already the bulkheads are being made good. They will control her when she is lifted. This ship has only a 8½ deg. list, and it is anticipated that she will not be so difficult to lift as either the "Moltke" or the "Seydlitz." At the time of writing the water within the hull has been forced down by compressed air to a depth of 21ft., giving access to all parts of the ship, and the bow and stern have been successfully lifted, enabling the bulkheads to be made good to the required depth. It is expected that the hull of the "Kaiser" will be ready for lifting in a few weeks.

Salvage of the battle-cruiser "Hindenburg," work on which was postponed in September, 1927, owing to a series of mishaps, will soon be resumed. A full account of the work which has already been done on the "Hindenburg" will be found in the issue of THE ENGINEER for October 1st, 1926, and we understand from Mr. E. F. Cox that it is hoped to float that vessel in the autumn of this year.

THE Reconstruction of Bridges Bill is a Government measure to facilitate the improvement and, where necessary, the reconstruction of weak bridges, for the maintenance and repair of which some person or body other than a highway authority was responsible. It is the result of negotiations which have extended over more than three years between the Railway Companies' Association, the Canal Association, and the County Councils' Association, with the assistance of the Ministry of Transport. The Bill was read a second time in the House of Lords on February 14th.

I

Institution of Mechanical Engineers

THE eighty-second annual general meeting of the Institution of Mechanical Engineers was held in London last Friday.

ANNUAL REPORT.

The annual report of the Council submitted at the meeting showed that there had been a net gain of 210 in the number of members and that the membership roll on December 31st, 1928, amounted to 10,466. Examinations for admission to the Institution were held in London and the provinces and in Australia, China, Egypt, the Federated Malay States, India, New Zealand, and South Africa. One hundred and four candidates passed the studentship examination and 274 the associate membership examination or sections of it. During the year a new branch of the Institution was formed to cover the East Midlands area with its headquarters at Nottingham. The Institution now has eight branches. Dealing with the research activities in which the Institution is interested, the report recorded the continuation at the National Physical Laboratory of the investigations being conducted for the Alloys of Iron Research Committee, a body with which several learned societies are concerned. The work performed dealt mainly with the alloys of iron with silicon, beryllium, manganese, and chromium. Considerable progress was made with the study of the iron-silicon and iron-beryllium alloys, but in the second named case experimental difficulties were encountered in connection with the manipulation of the alloys. Special pyrometer methods were developed in the case of the iron-chromium and iron-manganese alloys with the object of protecting the thermo-couples when immersed in the alloys and to avoid the chemical contamination of the molten alloys.

For the Cutting Tools Research Committee Professor Dempster Smith completed an investigation into the cutting of brass with high-speed and carbon-steel tools, and under Sir T. E. Stanton a research on the speed-effect characteristic of materials with a high ratio of yield stress to ultimate stress and comparatively low elongation was also completed. The second-named investigation showed that the variation of cutting force with speed cannot be attributed either to the high ratio of yield stress to ultimate stress nor to the effect of cold working on the material.

The final report of the Steam Nozzles Research Committee will, it is hoped, be issued this year. During 1928 investigations were carried out at Manchester principally with the object of clearing up doubtful points rather than that of breaking new ground. For the Wire Ropes Research Committee research work was continued at Woolwich Polytechnic under Dr. W. A. Scoble. Experiments are now proceeding on ropes of 2in. circumference, and the speed effect during bending and the extent to which the length of rope being bent affects its endurance are being investigated.

The financial statement accompanying the report showed that the Institution's revenue during the year amounted to £31,942 and its expenditure to £28,760.

Following the presentation of the annual report and its unanimous adoption, Mr. Daniel Adamson took the presidential chair in succession to Mr. Richard W. Allen.

REFRIGERATION ON SHIPBOARD.

At the conclusion of the business connected with the annual general meeting Mr. H. J. Ward presented a paper entitled "Refrigeration on Shipboard." This paper will be found reprinted elsewhere in this issue. The discussion which ensued was brief and added little of interest to the information contained in the paper.

Mr. Adamson having emphasised the importance of refrigeration to this country, both from the point of view of our food supplies and from that of shipbuilding for the meat-carrying trade, Mr. H. Brier was called upon to open the discussion. Mr. Brier gave a brief historical review of the development of the refrigeration industry, with which, he said, he had been connected for the past fifty-two years. Looking ahead, he said he thought pre-cooling and multiple compression would be likely developments of the near future. Their adoption would reduce the size of machine required for a given purpose and would save about 50 per cent. of the horse-power expended under conditions of tropical service.

Mr. A. R. T. Woods, of the Nelson Line, said that Mr. Ward had given the meeting a CO_2 paper. Both CO_2 and ammonia machines were efficient and did their work very well. Regarding the Board of Trade regulations covering the use of ammonia machines on shipboard, he stated that his line had employed such machines for twenty years on passenger vessels without experiencing any trouble. The modern refrigerating machine was very complex, but it enabled them to carry a cargo of chilled meat at a temperature which was constant to within one-quarter of a degree. That fact was a testimonial to the machine and the engineer in charge of it. Referring to the ammonia machine directly coupled to an oil engine, illustrated in the paper, Mr. Woods stated that the plant represented a great departure in the driving of ammonia compressors, and when his line first proposed the system little support was received from the manufacturers. Possible vibration was an important factor to be reckoned with, but with the assistance of Mr. Hamilton, of the Premier Gas Engine Company, all difficulties of that kind had been overcome and the plant had proved a conspicuous success.

Mr. D. Thom recalled the fact that the first refrigerating machines which were produced were made for marine use, and later they were applied to duties on land, one of the earliest of which was for solidifying paraffin wax. Refrigerating machines seemed to be reproducing the history of the steam engine. At first they were big and slow and were now becoming small and fast. No doubt we would soon reach the turbine-driven refrigerating machine.

Mr. A. H. Tyler said that he regretted to see the author's firm, J. and E. Hall, Ltd., tending to favour ammonia machines at the expense of CO_2 machines. He claimed that CO_2 machines had done good work in the past and were capable of doing still better in the future. They were distinctly superior to ammonia machines, and if they had not swept the board it was because the higher pressures used in them had frightened the early refrigeration engineers. It used to be considered difficult to make satisfactory joints to withstand the pressures used in CO_2 machines, but he had never known a failure with a properly applied copper ring jointing. Among the advantages of the CO_2 machine were the facts that the working substance was neutral and had no action on the metals with which it was brought into contact, that the higher pressures used reduced the size of plant required, and that the small compressors and large passages obviated trouble when flooding with liquid carbon dioxide occurred. He held that the CO_2 machine could be made as cheap as the ammonia machine, and that it would last just as long.

Mr. W. H. Patchell, referring to Mr. Tyler's remarks concerning pipe joints, asked whether in the case of steam pipe joints we were not tending towards the adoption of types with too much complexity. Could we not get back in the case of high-pressure steam pipe joints to the simplicity which characterised the joints used in refrigerating and hydraulic machinery practice?

Mr. H. J. Ward briefly replied to the discussion. Dealing with Mr. Wood's remarks, he said that the fact that 80 per cent. of the refrigerating machines at present in use on shipboard were of the CO_2 type probably accounted for the fact that Mr. Woods had received the impression from the paper that his firm favoured CO_2 machines. Messrs. Hall had, however, for many years past been interested in ammonia machines, and he himself was by no means an opponent of them. It was, however, in some respects easier for the designer to fit CO_2 machines into a vessel than to install ammonia machines. The direct oil engine-driven machine interested him greatly several years before Mr. Woods raised the question of employing it. He agreed with Mr. Thom that turbine-driven compressors were likely to be made in the near future. We were within sight of them in the case of ammonia machines for moderate pressures. At one time some engineers had been afraid of raising their compressor speed from 80–90 revolutions per minute up to 150 revolutions per minute. To-day machines were being run at 400 revolutions per minute without trouble. He agreed with Mr. Tyler that the CO_2 machine was not yet obsolete by any means.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

AMERICAN NAVAL CONSTRUCTION.

SIR,—Surprised as we have been at the amount of misinformation, inimical to the United States' naval programme, that has been and is now being disseminated by British periodicals, the extent of that surprise has never been quite so great as when we read certain statements in the January 4th, 1929, issue of THE ENGINEER, under the head "Naval Construction in 1928." Be assured that proponents of the naval programme now being considered by Congress are not afraid of the truth, but they do want the truth whether it be favourable or unfavourable to their cause. They expect its opponents, therefore, to be equally as fair.

In correcting certain points of the above-mentioned article we shall refrain from any expression of opinion concerning our Navy's present programme. Nor shall we attempt discussion of facts pertaining to navies other than our own. Our sole purpose is to emphasise certain things obviously not known about the United States Navy.

The statement that four flotilla leaders "are to be built in the near future" (by the United States) is incorrect. If the statement had read "may be built" no one could have taken exception to it; the guess would have been more accurate, perhaps, than the one THE ENGINEER printed. Actually, we have authorised construction of twelve of these valuable ships, but that authorisation dates back to 1916!

The Navy included these in its original five-year naval building programme, but they were thrown out when that programme was revised and put into the form in which it is now being considered by Congress. So far as authorities in this country know, we are not going to build these "in the near future;" indeed, in some quarters it is believed that they will never be built, due to the fact that cruisers are much more desirable. Congress is slow in making appropriations even for this latter class, and the idea that it will make an appropriation for flotilla leaders even in the distant future is unconscionable. Incidentally, another British magazine in high repute recently made the statement that we have "projected" nine flotilla leaders.

THE ENGINEER was correct in asserting that six battleships have been completely modernised. They are the "Texas," "New York," "Wyoming," "Arkansas," "Florida," and "Utah." Its further statement, which included these and five others and which said that the angle of elevation of the turret guns of all these is to be increased from 16 deg. to 30 deg., is incorrect. The guns in the main batteries of only two—the "Nevada" and the "Oklahoma"—could be given this increased elevation, interference with the gun ports precluding this change on any others. Moreover, the former maximum angle of elevation of these guns was 15 deg., not 16 deg., as stated in THE ENGINEER. The "Nevada" and "Oklahoma" are now in naval yards being modernised and having their guns changed.

The submarine "V 4" has a surface displacement of 2680 tons. THE ENGINEER quoted this as being 2890 tons. For your information may we also add that the "V 5" and the "V 6," now building, each will have a surface displacement of 2760 tons. THE ENGINEER's statement that it is believed they will have a displacement of over 3000 tons may have meant "submerged displacement;" but, if so, was misleading, following, as it did, so closely after the quotation of the surface displacement of the "V 4."

We are sure you will appreciate our stand for accuracy and, in justice to all concerned, publish a correction of the statements cited above. F. D. MCHUGH,

Associate Editor, *Scientific American*.

New York, February 6th.

[While we are indebted to our correspondent for putting us right about minor details of American naval construction, we cannot accept his implied suggestion that we are among the "opponents" of the American naval programme. That implication is gratuitous, and, so far as THE ENGINEER is concerned, quite unfounded. We invite our correspondent to read a leading article on the American Cruiser Programme in our issue of December 7th, 1928, and then to do us the justice to admit that we have been scrupulously fair to American views. With regard to the flotilla leaders, our information—derived from American sources—was to the effect that four of these vessels were to be substituted for the twelve destroyers left over from the 1916 programme. In our allusion to the modernisation of United States battleships we thought we had made it clear that an increase in turret gun elevation was only to be undertaken in the case of the newer ships. If our correspondent will read the article again he will find that we said the gun elevation was to be increased in ships from and including the "Oklahoma" and "Nevada." The discrepancy in the figures of submarine displacement may be due to differences between normal and "standard" displacement. The figures we gave were official in origin, and we have no reason to doubt their accuracy. For the rest, it was certainly not our intention to exaggerate the size or power of United States warships. We are wholly in favour of that meticulous regard for exactitude in naval data to which our correspondent attaches so much importance.—ED. THE E.]

THE PRODUCTION OF STEAM TABLES.

SIR,—Will you kindly permit me to call attention to certain inaccuracies in your editorial on "The Production of Steam Tables," on page 47 of your issue of January 11th, 1929, where you quote my statements on the Steam Table before Section J of the World's Power Conference on September 28th, 1929? The stenographic record of the proceedings sent me by the Secretary of the Conference reads as follows: "All these researches were coming to a conclusion, and it was hoped that the results would be available by December 1st, 1930, apart from the question of the specific heat of superheated steam. Meanwhile, the General Electric Company had been so interested that they put some of their men to work on a calculation of a new total heat entropy chart, which it was hoped to have published by December. Later a tentative table would be published, but the final results would be held up until entire international co-operation had been secured by the experimenters in Great Britain, Germany, Czechoslovakia and the United States."

This statement was made by me after a conference with the Steam Table Committee of B.E.A.M.A. on September 27th, 1928, where I was informed that their new tentative table to 4000 lb. would soon be published, and that they would soon send us Callendar's experimental points, without which any checking with English results has been impossible. The General Electric Company has most generously allowed Mr. Keenan to publish the new total heat entropy diagram—*Mech. Eng.*, February, 1929—and has also offered the new table to the profession for later publication. Since October the new Knoblauch results have been made public—*Z.V.D.I.*, December 1st, 1928, and *Mech. Eng.*, February, 1929—and with the publication of Callendar's experiment points, the long and arduous work of comparison and checking of results may be put under way. A conservative estimate of the time necessary for this work is perhaps sixteen months. On the completion of this work, we shall be ready for an international agreement on the fundamental data from which a steam table may be calculated.

This agreement will probably take a similar form to the international agreement on the temperature scale, but with a larger number of points.

Steam table formulations and equations of state are a different matter, and it would appear to me most unlikely that agreements along this line could be secured. However, if agreement can be secured on a sufficient number of points, the discrepancies between tabular values for thermal, temperature, pressure and volume quantities should be reasonably small, and not of any particular importance.

It should be noted that the published total heat entropy diagram was reduced from an original about 4ft. wide and approximately 14ft. long. Two copies of this full-sized chart, through the courtesy of the General Electric Company, have been in B.E.A.M.A.'s hands since the first of the year.

GEO. A. ORROK,
Chairman, Executive Committee,
Steam Table Fund.

New York, February 6th.

DISTANT SIGNALS.

SIR,—As an old reader, as my father was before me, of THE ENGINEER, I look forward to your remarks on recent railway accidents and your suggestions for remedies, from which your readers can base inventions for safety of British railways.

It struck me on reading the account of the Ashchurch Ministry of Transport inquiry in the *Daily Express* of February 2nd that many people might be misled and attempt to invent "train control" apparatus connected to our present distant signals.

The point I want to make is for your readers to know that it will only end in disaster. Distant signals, on the whole, work well, and locking makes them so that they cannot be pulled to "clear" unless points and home and starter are correct. They are the key signal, and drivers trust to them and run at such a speed—when at "clear"—that they cannot stop at any home or outer home.

But distant signals fail far more often than is supposed, and the usual method of reporting is that the driver tells the signalman, and the signalman has it put right, and there it ends. I do not think any pressure put on drivers to report will reveal the truth, as drivers are very loath to report, as it involves reporting another department, on one hand, and also reporting not only the signal but the signalman for not noticing that the signal had not gone back to "danger," and more attention would be given to that than to the signal, and drivers and signalmen are always in touch with each other and good pals.

Below I give a few features about distant signals:—

Weight on lever pulls wire back when lever is put back in signal-box.

Fail when frost contracts the wire; often in early morning after warm day or two.

If foggy, driver's angle of view looks up at the signal, it half on; in clear weather he will look at it from a distance and see half and half, which is a "danger" signal by rule.

Fail when white frost gets on pulleys or snow drifting into parts.

Fail when post is on an up gradient and weight has to pull wire up hill; this will perhaps work right for years, and then fail unexpectedly.

Fail if signal-box has been switched out all night or week-end, and signals have been "off" and will not respond at once. A few vigorous pulls on lever mostly put these right.

I have known signals "off" and go "on" when a train runs by. I think this the most deadly of all failures, and it cannot be proved.

I cannot speak of failures of electrical repeaters, as all cases I have known personally, the repeaters have shown "signal down," which, as I said, would get the signalman into trouble.

AN OLD DRIVER.

February 16th.

SCIENCE AT THE SCIENCE MUSEUM.

SIR,—Will you allow me through your columns to call the attention of the distinguished engineers and men of science who form the Advisory Council of the Science Museum to two matters. These matters are (1) the system of artificial lighting, and (2) the noisy conditions often obtaining.

Everyone will admit that in a science museum everything should be on scientific principles. But what does one see as regards the artificial lighting? Here are lamps embedded in ceilings; ceilings a chequer of shadows; thickly frosted globes with heavy metallic fittings, and lights placed on the tops of beams, each of which casts a shadow on the very objects it is desired to illuminate. The lighting of the locomotive gallery is perhaps the most curious and most unsatisfactory piece of lighting in any public building in London. What the use of the lamps on top of the beams is, I cannot understand. Engineers may have much to learn from the architects, but it is certain the architects have much to learn from the illuminating engineers. The lighting bill for the Museum must be a pretty stiff one, and yet on a dull day or of an evening it is almost impossible to see the details of the exhibits, much less to read some of the labels. The whole system wants altering.

If more light is desirable, so, too, is less noise. I suppose the Science Museum on a busy day is the noisiest museum in the world. This arises from various causes, one of which is the traffic over the thousands of square yards of hollow wood flooring. To walk quietly on this, one needs the feet of a cat, and seeing that the Museum is often thronged with boys wearing nailed boots, even moderate quietness is impossible. A certain amount of linoleum has been laid down, but there are galleries where there is none. Another source of noise is the tramp of feet up and down the stone staircases and another the opening and closing of the gates of the lift. As most of your readers know, lectures are given by two engineers in the Museum. How they carry on amid these various noises I do not know. I am informed that many representations have been made about these things, and that the Board of Education has asked the Office of Works to alter the gates so that they may work quietly, but that the Office of Works reply that it is impossible. What an admission to make in 1929! But, Sir, I imagine this is only an instance of that departmental inertia of which we hear occasionally, and that some day, either the Office of Works or the lift makers will wake up and find that it can be done. These, however, are matters upon which the Advisory Council are well able to judge.

February 16th. X.

ENGINEERING PRINCIPLES IN THE MACHINERY OF THE STARS.

SIR,—I should like to write a few lines in respect of the lecture by Professor Eddington which was published in THE ENGINEER of February 8th. As an engineer and not a physicist I naturally look at the subject in a different light.

I assume that Professor Eddington is not only showing a possible mechanical reason for the apparent variation of brilliancy of some of the stars, but also that the "heat engine" principle is the possible source of energy which maintains the celestial bodies in their orbits round the sun.

If we realise, first, that each planet has a force (electrical) of its own, which we term in the case of ours "force due to gravity;" secondly, that each and every planet rotates round its own sun centre in an elliptical orbit; thirdly, that each planet as it rotates in its orbital path generates electrical energy in much the same way as a dynamo with the poles rotating round a stationary armature, which energy is focussed at one central point, the point we know as its sun; fourthly, that this generated electrical energy exerts a force on the planets, drawing them for certain periods, *i.e.*, from the major diameter to the minor diameter, nearer to this central point, and their momentum carrying them through the next quarter of their orbit, during which time they are generating, then the sun as we see it, and all other suns as well, are not bodies, but simply a raised potential due to the electricity continually generated by the planets rotating around them and acting as one unit for each system.

Further, as each planet rotates in its orbit through space devoid of matter, there is not any friction and hence the wonders of the universe and the continuity of the planets to rotate in their respective orbits. Where a star is observed to vary in brilliancy this might be caused by a varying potential produced by the planets in that particular system.

The above theory, I admit, is difficult to conceive, as we cannot bring our minds to think of the enormous electrical pressures generated. It is, however, one theory and, like others, remains to be proved; but I certainly believe it to be sound. AN ENGINEER.

February 18th.

FEED WATER RESEARCH IN AMERICA.

SIR,—In your leading article of the 8th inst., you say, in relation to the general question of boiler feed-water control: "In large power stations the problem is almost universally solved by the use of evaporators, about which there is surely little that remains to be discovered. In smaller plants, and especially where make-up water is of necessity considerable, softening by means of lime and soda or the zeolite process is almost equally standard practice and is equally well understood. The trouble with feed water does not consist in ignorance as to suitable treatment, but rather in the continual supervision required to ensure that the treatment is properly carried out."

I would venture to suggest that neither of these treatments can be looked upon as final. Evaporators produce pure water, free from solids, but also allow CO_2 from bicarbonates to pass, also other volatiles, such as ammonia. Water containing temporary hardness, therefore, needs a supplementary lime treatment or subsequent deaeration, and probably addition of caustic soda in the boiler, coupled with sodium hydroxide for the prevention of embrittlement, in a ratio of anything up to 5 to 1 for the highest pressures.

You very rightly observe that the boiler is no place for carrying out chemical processes, and one of the results of all this treatment is that we have increased the concentration in the boiler and so neutralised much of the good that the evaporators have done.

The lime soda process proves satisfactory in suitable circumstances, but it cannot be relied upon to pass less than about 2 grains per gallon hardness.

The zeolite process has the disadvantage that it passes sodium carbonate to the boiler when used on a water containing temporary hardness, thereby incurring the additional expense of a supplementary lime treatment.

E. C. HARRIS.

Hornchurch, Essex, February 14th.

CANALS AND TRANSPORT.

SIR,—Our canal advocates are at it again, telling us how we have neglected our waterways, what canals have done to cheapen transport abroad, how we might have cheap transport, and urging expenditure on a great British canalisation scheme. What misconception!

Inland water transport can only be economical where there are big rivers flowing through comparatively level country; where the water supply is ample and easy; where the levels are favourable. Most of industrial Britain is hilly and destitute of rivers suitable for canalisation. On our existing canals the average rise or fall is over 10½ft. per mile. On the Continent it is less than 1½ft. Barges on the Continent can travel scores and sometimes hundreds of miles without encountering a lock. Here we have nearly as many locks as miles. All the way from Berlin to Hamburg there are only three locks, the country is so flat. Between Birmingham and the Thames, a shorter distance, we have over 150 locks. We have more locks on 200 miles of British canal than can be found on 10,000 miles of foreign canals. Such being the case, canal construction is extremely costly in our country, maintenance is costly, and navigation is both slow and costly.

In the one district where we have favourable natural conditions for canal transport—on the Aire and Calder Navigation—where we have tide water from Hull to Goole and flat country from Goole nearly to Leeds and Wakefield, the canal people do not manage to carry one ton of coal to Hull for every ten tons carried by the railway. In other districts the conditions are vastly more in favour of the railways. It is no more possible to make Britain a first-class canal country than it would be possible to make Switzerland—or Tibet—a first-class ocean shipping country. An endeavour to do so would be a costly wild-cat scheme. It is time our canal advocates faced facts and dropped their delusion. Please let me add that I write as one actually reared on canal barges, and as one who has practically studied British and foreign conditions many years. E. T. GOOD.

Sheffield, February 19th.

L.M.S. HIGH-PRESSURE LOCOMOTIVE.

SIR,—I think Mr. Thompson is rather straying from the point. No one in his senses would deny that the French compounds are remarkably successful machines when driven by Frenchmen; but I doubt if there is any evidence that they offer any material advantage over the best British designs.

I would point out that the Paris, Lyons and Mediterranean Railway have themselves ordered a high-pressure locomotive from Messrs. Henschel, so evidently they think that the German design might prove superior to their own. C. M. KEILLER.

Cookham Dean, Berks., February 16th.

SIXTY YEARS AGO.

THE "safety" bicycle of to-day seems to be such a simple and straightforward piece of mechanism that it is not very easy to understand why its evolution occupied so much time. The motor car and aeroplane had to await the development of the petrol engine, but the bicycle of to-day—pneumatic tires excepted—was within reach of the mechanical abilities of our forerunners sixty years ago. Yet another sixteen years were to elapse before anything approaching the modern type—Starley's "Rover" bicycle of 1885—was produced. The "bone-shaker" bicycle had been imported into this country from Paris in 1868. It was known as the "French velocipede" at first. It had the pedals directly attached to the axle of the front wheel, which was slightly larger in diameter than the rear wheel. Since the drive was direct, no great speed could be obtained on it, and as the driving wheel was also used to steer the machine much skill was required to ride it. In our issue of February 19th 1869, replying to a country subscriber, we stated that French velocipedes could be obtained from A. Davis, saddler, in the Strand. From a letter in the same issue, written from Dublin by one who signed himself "R. W. W.," C.E., we gather that at that date "the whole world had evidently gone mad on velocipedes." Walking, the New York wits said, was on its last legs. Men and boys were whizzing here, there and everywhere at a speed of twelve miles an hour. Inventors were improving the machine, and manufacturers were producing them wholesale. Something was bound to come of it. Perhaps in two years' time as great a change in our means of communication would be wrought as the railways had effected. Mr. "R. W. W." had himself been caught up in the toils of invention, and had designed a machine with which he intended shortly "to make a little splash in the Dublin streets." His invention was a one-wheel velocipede, of which we gave an illustration. His wheel was 8ft. in diameter. Four spokes on each side were curved outwards to give a width of 3ft. 6in. between the wheel bosses. A two-crank axle extended between the bosses and from the cranks a pair of stirrups descended. The rider sat inside the wheel on a seat attached to a weighted rod hung pendulum-wise from the mid point of the axle. The inventor thought that the machine would be easy to ride and very speedy, and that it would be very safe because even if it toppled over the rider, being virtually inside a wire cage, would escape injury. We do not know whether "R. W. W.'s" "little splash" came off or not. Other inventors followed other lines. That very year, 1869, saw the introduction of the "ordinary" or "penny-farthing" bicycle with its large front wheel, still directly driven, and its minute follower. For nearly two decades the "ordinary" bicycle held the field. Not until Starley produced the safety bicycle with a chain-driven rear wheel and a front steering wheel did cycling become a popular pastime among others than athletes and certain daring spirits.

The British Industries Fair at Birmingham.

No. I.

In our issue of February 15th we published special Supplements dealing with some of the exhibits at the Birmingham Section of the British Industries Fair, which was opened on Monday last. To-day we again publish special Supplements descriptive of further exhibits, and in what follows below we begin our reference to still further exhibits which it was impossible to include in the Supplements.

Fielding and Platt, Ltd.

On the stand of Fielding and Platt, Ltd., of Gloucester, there are to be seen two examples of the firm's latest type of heavy oil engines, which incorporate new features of design and are now made to start from cold without the use of heating lamps, electric starting plugs or fusible cartridges. The engine we show in Fig. 1 has a designed output of 55 B.H.P. at normal load with a 60 B.H.P. overload rating for half-an-hour. The cylinder bore is 12½in. with a stroke of 22in., and the normal running speed is 240 revolutions per minute. The second engine has a 45 B.H.P. normal output with a 50 B.H.P. half-hour overload rating, and is generally similar in design and construction.

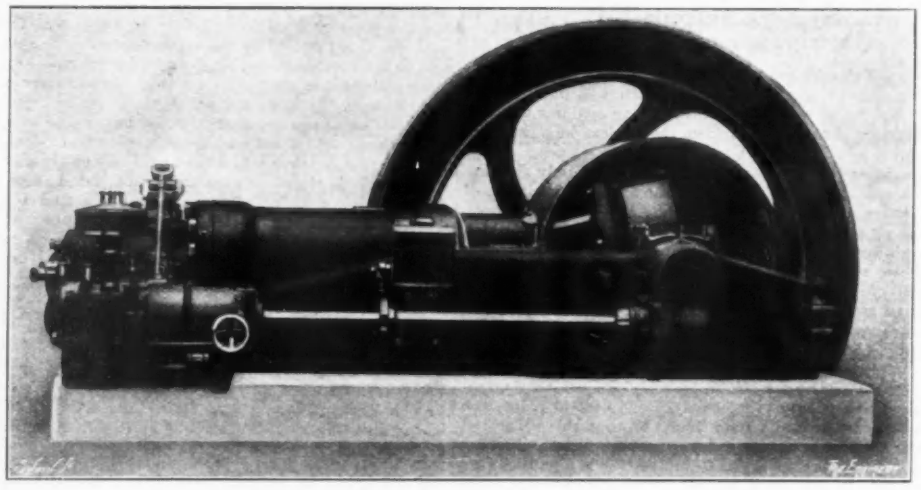

FIG. 1—55 B.H.P. COLD-STARTING HEAVY-OIL ENGINE—FIELDING AND PLATT

The main bed-plate is of robust construction and it is cast in one piece with the cylinder jacket. The cylinder head is bolted direct to the jacket and it carries the dual combustion chamber and the valves. The primary combustion chamber is entirely separated from that on which the air and exhaust valves are placed. When the oil is injected towards the end of the compression stroke combustion takes place in the primary chamber, which is entirely water cooled, and the gases exhaust into the second chamber through a specially shaped port. By this means the valves and valve seatings are protected from heat stresses and the necessary turbulence to ensure complete combustion with a good fuel consumption is obtained. The maximum combustion pressure at full load does not exceed 450 lb. per square inch, and a consumption of 0·42 lb. of oil per brake horse-power hour is obtained on the larger sizes of engine with 0·46 lb. on the smaller engines. The fuel pump is arranged at the side of the cylinder head and is neatly combined with the governor unit. Only the middle portion of the fuel pump stroke is utilised. The plunger is hollow and contains two by-pass ports, one of which cuts off the fuel at a definite point, the other being controlled by the governor which actuates a concentric sleeve on the fuel pump plunger. A low fuel injection pressure is employed and a comparatively large orifice with a non-return valve is used on the patented fuel sprayer. Lubrication is effected by a mechanical lubricator driven from the side shaft in the usual manner.

Hadfields Ltd.

Progress is still being made in the domain of high-grade steels, and many special steels, possessing qualities which fit them for practical applications under circumstances where other and less efficient materials have been used in the past, are exhibited on Hadfield's stand. Some of the most important of these are the Hadfield "ERA/HR" heat-resisting steels. The examples exhibited clearly demonstrate the wide variety of uses to which these special alloys have already been put. They are remarkable for their extraordinary strength at temperatures up to 900 deg. Cent. Hence they are peculiarly adapted for all classes of work involving high temperatures and those subjected to the oxidising effect of highly heated and sulphurous gases. We are told that they are rapidly finding new uses and there is an increasing demand for them for retorts, large furnace muffles, case-hardening boxes, conveyor chains subjected to the heat of furnace gases, air heating tubes, and appliances for the glass-house, power plant, and all types of melting furnaces. As a result of trials by a British Government department in which material was required to remain perfectly rigid in the form of castings and forgings at 850 deg. Cent., the firm's "ERA/HR" heat-resisting steel has, we are informed, been adopted on a considerable scale. Demonstrations are being carried out on the stand to illustrate the heat-resisting and non-scaling properties of these steels.

Another steel, which will perhaps appeal to the general public more than the preceding one, is the firm's "ERA/CR" non-corroding steel, which is a steel that takes an excellent polish and can be given a very artistic finish. For this reason it is becoming increasingly used for domestic utensils, motor car and ships' fittings, and for other articles that require a permanent bright finish. A variety of articles of an ornamental character and for domestic purposes, cold pressed from "ERA/CR" non-corroding steel sheet, are shown. As this particular steel is completely resistant to a wide range of chemical agents its greatest usefulness is to be found in the construction of plant used in the numerous large-scale processes appertaining to the chemical industry. The range of chemical agencies which this material successfully resists include mineral and organic acids, sea water, and corrosive salts, such as chlorides and sulphates. Being also resistant to the attack of fruit juices, beverages, and condiments, it is an excellent material for the food industries. It is also suitable for use under marine conditions, and for constructional parts of aircraft. "ERA/CR" non-corroding steel can be rolled, forged, cold pressed and cold drawn, and in addition to the articles above mentioned there is a display of tubes made in this material of various sizes and gauges. There are also articles suitable for the manifold requirements of the chemical and allied industries.

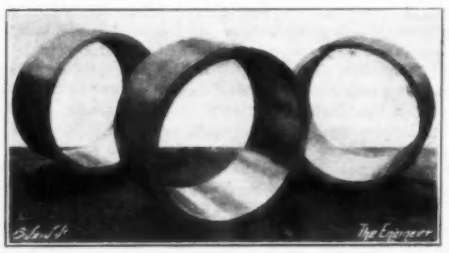

FIG. 2—RETAINING RINGS—HADFIELD

For the retaining rings of the armatures of turbo-electric generators a special combination of properties is required. These rings—see Fig. 2—which are situated at the ends of the armatures, hold the electrical windings in place and are subjected to high centrifugal stresses owing to the rapid speed of rotation. Thus a material of high tenacity is called for. Further, it must be non-magnetic, otherwise there would be a diversion of the magnetic field through the rings, away from its proper path across the interpolar space and through the windings. To this requirement must be added machineability.

In their new "Resista H.Y." steel Hadfields, Ltd., have provided a material which combines all these requirements. A specimen retaining ring machined from "Resista H.Y." steel is exhibited, while other specimens illustrate its high tenacity and machineability, including turning, planing and shaping, drilling, slotting and screw cutting. Under the tensile test a yield point of 35 to 40 tons per square inch is obtained, the tenacity of the material being about 50 tons per square inch with an elongation of 30 to 35 per cent. At the same time the material is non-magnetic, its specific magnetism never exceeding 0·1 per cent. pure iron, being reckoned as 100.

While non-magnetic steels are no longer a novelty, in the past this property has been associated with extreme difficulty in machining. A low yield point has also been characteristic of most non-magnetic steels. "Resista H.Y." steel, therefore, represents a distinct advance, which is due not only to its special composition, but to special processes of manipulation.

Hadfields manufacture steel forgings and steel castings of every description, and as an example of these manufactures in the heavier class of their work a section cut from a cast steel hydraulic cylinder 20ft. long is exhibited to show how thin the walls can be cast in their steel. Finally, there are examples of the firm's latest high-speed steels.

James and Fredk. Howard, Ltd.

The locomotive illustrated in Fig. 3, exhibited by James and Fredk. Howard, Ltd., of Britannia Ironworks, Bedford, is designed for use on rough temporary tracks having steep gradients and sharp curves. All petrol locomotives from 2 to 6 tons capacity are fitted with British made four-cylinder engines, and they are guaranteed for a period of twelve months. They are of the four-cylinder monobloc L-head type with large water spaces, and under average working conditions the petrol consumption is from 0·62 to 0·7 pint per brake horse-power hour. Automatic forced feed lubrication ensures a positive supply of oil and an oil pressure indicator is fitted within the view of the driver. Ignition is provided by a high-tension magneto and water circulation by pumps and a cooling fan. The locomotives can also be supplied fitted with the latest type of Blackstone crude oil engine, provided with patented high-speed spring injection and designed to run successfully on all standard Diesel fuel oils as well as on gas-oil, shale oil and paraffin. By means of a small petrol motor the main engine is easily started. The 2-ton and 2½-ton locomotives are fitted with 17½ B.H.P. twin-cylinder Blackstone crude oil engines, whilst the 4 to 6-ton locomotives are fitted with 35 B.H.P. four-cylinder Blackstone crude oil engines.

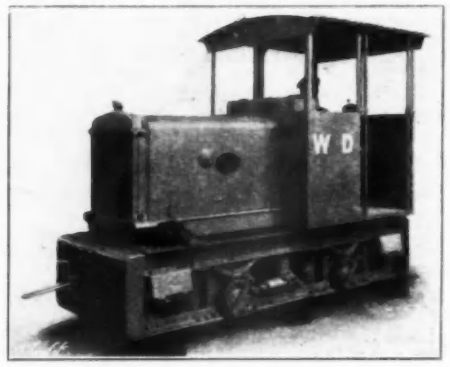

FIG. 3—PETROL LOCOMOTIVE—HOWARD

George Salter and Co., Ltd.

This year the stand of George Salter and Co., Ltd., of West Bromwich, is larger than usual, and the firm's products are shown to good advantage. For over 160 years this firm has been engaged in the manufacture of spring balances and weighing machines controlled by springs, and suitable for domestic and trade purposes.

Probably the most striking exhibit is a spring balance designed to register up to 100 tons, which is claimed to be the largest spring balance in the world. It is for use in connection with a crane, and it enables a load to be weighed whilst it is being hoisted. This type of spring balance is made in sizes ranging from 10 cwt. up to over 100 tons, and is as supplied to the Admiralty, dockyards, ironworks, &c. The firm has long specialised in the manufacture of springs suitable for all important work. Springs for heavy work and made from steel of 3in. square or 3in. round section, are on view, as well as very small springs of all designs made from steel as fine as ·002in. Research work is continually carried out on special classes of steel, and springs are made which can be subjected to great temperatures. Springs composed of steel, stainless steel, phosphor bronze, brass, monel metal, &c., are among the firm's products. An arrangement is exhibited of light springs carrying small weights, &c., which illustrates the periods of vibrations of springs.

The firm is also showing some light grey iron castings, with fine sections of filigree work. Among other engineering articles exhibited is a cement-testing machine, which is a very interesting piece of machinery. It is enclosed in a glass case, and is

finished in black enamel and nickel plate. The apparatus is made to meet the requirements of the British standard specification for cement testing, and is simple and accurate in its working. Other testing machines shown are for such purposes as arriving at the tensile strength of yarn, wire, rope, cotton, string, &c. Numerous types of pressure gauges are to be seen, including air, water, steam, vacuum, petrol, oil, ammonia &c., manufactured to meet the requirements of the particular type of duty for which they are intended. There is also a collection of gauges as supplied to the Admiralty, and an electric control pressure gauge, for the purpose of controlling an electric motor driving a pump, when the pressure on the gauge exceeds or drops below a predetermined value.

Of special interest to tradesmen is a specially designed double-dial spring balance, designed to weigh 30 lb. by 1 oz., and fitted with dashpots to facilitate quick weighing. The dial is of large diameter, with the ounce divisions wide apart. This balance has been recently approved by the Standards Department of the Board of Trade. There is also a circular balance fitted with chains and hooks, designed for weighing motor cycles for local taxation purposes, and balances specially adapted for the grading and weighing of eggs. A similar range is available for the weighing of poultry, which falls into line with the special report of the Ministry of Agriculture and Fisheries on the Marketing of Poultry. A small, compact and light balance shown is designed to weigh up to 8 oz., and to indicate in drams. It is intended mainly for weighing food for diabetic patients, and serves to demonstrate the extreme sensitiveness of modern spring balances. Mention should also be made of spring balances designed for weighing milk, which are used extensively by large dairies and farmers.

A new design of balances in porcelain cases is shown. They are made to weigh up to 14 lb. by 1 oz., and are suitable for household use where a special finish is desired. Equivalent or calculating balances exhibited are valuable for stocktaking or estimating purposes, as a sample article placed in the scale shows the weight of metal contained in a gross without any calculation. They are made to indicate either the weight per gross, per hundred, or per dozen.

Ruston and Hornsby, Ltd.

The machinery exhibited on the stand of Ruston and Hornsby, Ltd., of Lincoln, is representative of the firm's activities in oil engines, pumps, boilers, and excavating machinery. Two oil engines are exhibited, showing both the horizontal and vertical designs. In Fig. 4 we illustrate a 20 B.H.P. single-cylinder horizontal engine, which is designed to give its output at a speed of 310 r.p.m., and has a bore of 8¼in., with a stroke of 15in. Engines of this particular type are constructed in sizes ranging from 16 B.H.P. up to 340 B.H.P. These units are all of the cold starting type, and are designed to work on a wide range of fuels, including residual oils of 0·93 specific gravity.

The vertical type of cold starting engine which has been developed recently for electric lighting and power work both on land and at sea, is exemplified by the three-cylinder 100 B.H.P. model, shown in Fig. 5. This engine has a cylinder bore of 10in., with a stroke of 15in. and its normal speed is 350 r.p.m. It embodies a patented form of fuel-distributing gear, the object of which is to ensure equal distribution of fuel to all cylinders, and so avert the danger of one cylinder carrying more than its own share of the load. Multi-cylinder sets, up to 1000 B.H.P. output, are built, and in the larger engines the valves are worked by oblique rods and levers operated from an oscillating shaft and not from the cam-operated vertical push rods, as shown in Fig. 5.

Among the pumps shown are two centrifugal pumps designed for lifts up to 50ft. and 200ft., and outputs up to 100 gallons and 180 gallons per minute, while a ram pump is also on view, which is designed to work at heads up to 150ft., and outputs up to 400 gallons per hour.

The boiler exhibit comprises a Ruston "Thermax" vertical type boiler, with a designed working pressure of 120 lb. per square inch, and a heating surface of 57 square feet with a grate area of 4·9ft. The design is one for which the firm claims the advantages of quick and economical steaming, with ease of accessibility for cleaning. These boilers are built in standard sizes, varying from 2ft. 9in. in diameter and 6ft. 9in. high to 5ft. 7in. in diameter and 14ft. in length.

FIG. 6—BACK-ACTING TRENCHER RUSTON

A special exhibit takes the form of one of the firm's No. 4 standard excavating machines, which is arranged to operate as a back-acting trencher. A view of the machine engaged in trench-digging operations is reproduced in Fig. 6. The machine is one which can be readily adapted to oil engine, steam engine or electric drive, and the design shown is fitted with a four-cylinder petrol-paraffin engine with a designed output of 32 to 35 B.H.P. at 1000 r.p.m. The engine is water-cooled, and a suitable fan and radiator are fitted. The power is transmitted to the travelling tracks and digging equipment through a dry plate clutch and totally enclosed gearing. The controls are conveniently arranged for one man operation and take the form of "servo" fingers or clutches, which are moved by the operator's levers and work the main clutches. The caterpillar tracks are so arranged that they can be run, either in a forward or backward direction, and for purposes of steering either track may be locked in position by means of a jaw clutch. The links have a broad bearing surface, which enables the machine to travel on almost any type of road or ground surface. The weight of the machine is about 14 tons, and it proceeded under its own power from the Bromwich Castle sidings to the position it occupies in the Fair buildings. By means of a special equipment which can be easily fitted, the machine can be made into either a full-circle, half-cubic-yard excavator, a shovel, a drag line excavator, or a skimmer scoop and grab crane. As exhibited at the Fair, the machine is arranged for digging trenches to a depth of 10ft., and it has been successfully employed for this purpose on new housing schemes.

West's Gas Improvement Company, Ltd.

On the stand of West's Gas Improvement Company, Ltd., of Manchester, there is a complete working model, designed and built in the company's Manchester works, of a typical installation of Glover-West vertical retorts equipped with an electrically driven West lip-bucket conveyor and embodying all the familiar features of this system of carbonisation. Every component part of the installation is a faithful and true reproduction of its original, and the model demonstrates the action of all mechanical apparatus, even to the small but important ratchet and worm gear operating the extractor helix. It is possible to follow the passage of the "coal"—seed is used as a substitute—from the storage bunkers above the retort bench, through the coal feed hopper and into the retort, and its discharge after "carbonisation" into the lip-bucket conveyor which elevates and dumps it into the bunker again.

A full-size section of the newly introduced West "Key" retort has been built and is exhibited with the top course detachable so that the key bond can be examined and the rigidity of the tie be appreciated. Specimens of refractory and insulating brick construction for vertical and horizontal retorts and for kilns, ovens, furnaces, &c., are shown by the Derbyshire Silica Firebrick Company, Ltd. On the same stand West's Rotinoff Piling and Construction Company exhibits a working model of shell piling apparatus. The observer can see perfect replicas of the West-Rotinoff semi-cylindrical concrete shell piles placed round the helical mandrel, driven section by section into sand, and the hollow pile filled and set exactly as in actual practice. In this instance also all working parts are accurately reproduced and the action of the whole apparatus is a true demonstration of the original. A wide range of photographs and diagrams illustrate the operation of the plant, of the types exhibited, in gasworks throughout the world.

Filtrators, Ltd.

On the stand of Filtrators, Ltd., of Astor House, Aldwych, London, W.C. 2, there is shown a complete plant for treating boiler feed water, which includes a "Filtrator" and the company's newly introduced continuous blow-down and heat recovery plant. In Fig. 7 we show a typical "Filtrator." It consists essentially of an outer cast iron cylinder furnished with fins for air cooling with an inner perforated cylinder which is filled with commercial linseed. The inner cylinder is held in position by the stirrup and screw which secures the cap as shown. Live steam is supplied to the central tube of the inner cylinder, and this steam, by passing through the linseed and then condensing on the walls of the outer cylinder, forms a mucilage which possesses the properties of a colloidal solution. This mucilage is allowed to flow continuously into the feed water through a regulating valve. In the arrangement shown in Fig. 8, which is a diagram of the plant exhibited, as will be seen, a

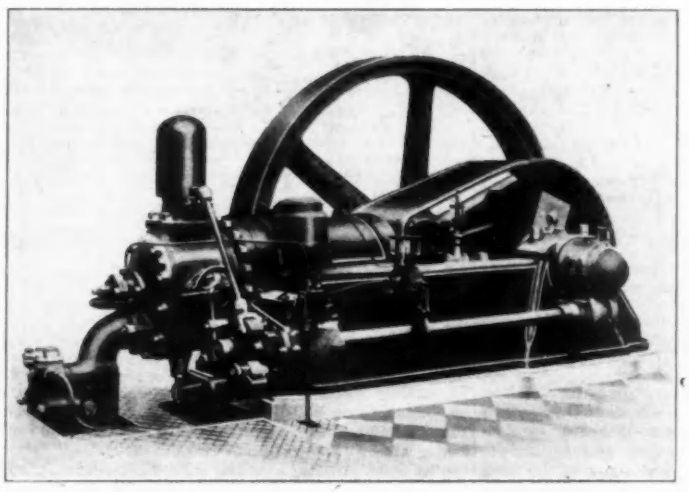

FIG. 4 20 B.H.P. HEAVY-OIL ENGINE RUSTON AND HORNSBY

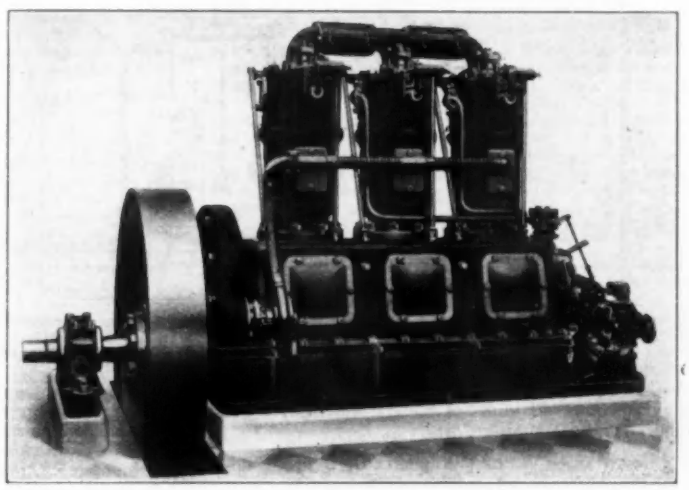

FIG. 5—100 B.H.P. HEAVY-OIL ENGINE—RUSTON AND HORNSBY

blow-down valve with interchangeable orifices is attached to the ordinary blow-down connection and is led to the blow-down receptacle, which is furnished with a central valve pressure gauge, water level gauge and a sludge removal cock. The amount of water blown down can be continuously regulated by the size of the orifice, and depends on the nature of the water supply. As the blow-down water passes to the receptacle at a pressure up to 20 lb. per square inch, part of it is flashed over to steam at the lower pressure within the receptacle and is discharged by the pipe A to the feed tank as distilled water. About 15 per cent. of the water is flashed off in steam in this

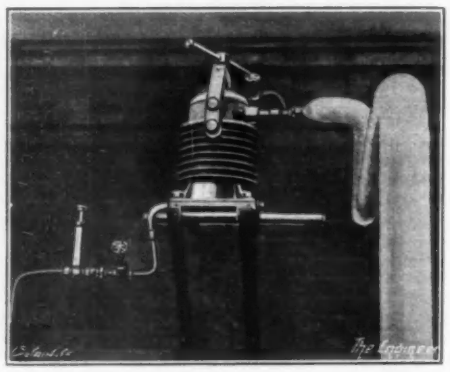

FIG. 7—FILTRATOR

way. The other water passes down the baffle within the receptacle and, rising on the other side, any sludge which may gather can be blown down perhaps once or twice during the week. The clear water passes along the connection B to the feed tank. A third connection C is provided for the purpose of density control in the form of a permanent discharge. By adjusting the blow-down cock at the foot of the receptacle any desired amount of water can be blown to waste and the density of the feed maintained constant. The heat from this water is received in a coil immersed within the feed tank. As shown, a standard "Filtrator" delivers a linseed mucilage solution into the feed tank. It is claimed that the feed treatment is non-chemical, and that by a physical process all the scale forming particles which are found in boiler feed water are coated by the colloidal starches extracted from the linseed. By this means they are prevented from adhering to each other and to the heating surfaces, and the formation of hard scale is thus prevented. It is further claimed that the colloid solution will also absorb oxygen and will prevent corrosion from acid or electrolytic corrosion. The soft sludge formed can quite well be removed by the continuous blow-down

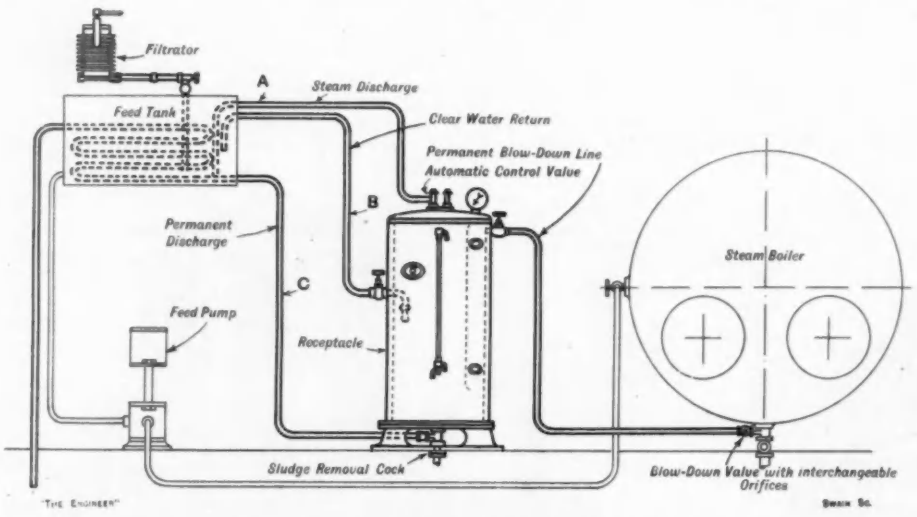

FIG. 8—BLOW-DOWN AND HEAT RECOVERY PLANT—FILTRATORS

system we have described. The system is capable of application to all kinds of boilers and also to condensers and economisers.

JAMES WARD (WORCESTER), LTD.

Automatic four-slide wire or strip-forming machines are among the exhibits of James Ward (Worcester), Ltd., of Eagle Works, Broad-street, Worcester. These machines, which are built in several sizes to deal with wire up to ½in. diameter, will take wire direct from a coil, straighten, draw the required length, cut off, form and eject thousands of wire forms, according to the tools fixed to the four forming slides and the central tool. The term "four slide" is somewhat erroneously applied, since actually a four-slide contains six or more slides, but the term is used in the broader sense to define between two, three or four "forming slide" machines.

The machine can be adapted to deal with strip material of equivalent section. A general idea of the mechanical features can be gathered from the illustrations, Figs. 9 and 10.

Four slides are actuated by positive action cams to and from a central fixed tool which is mounted in a heavy box section tool head 1. On each of the four forming slides an adjustable tool holder is mounted, and a suitable tool to form part of the required shape. One wire form is produced at each revolution of the cam shafts, which are all geared together. The wire from the coil is threaded through

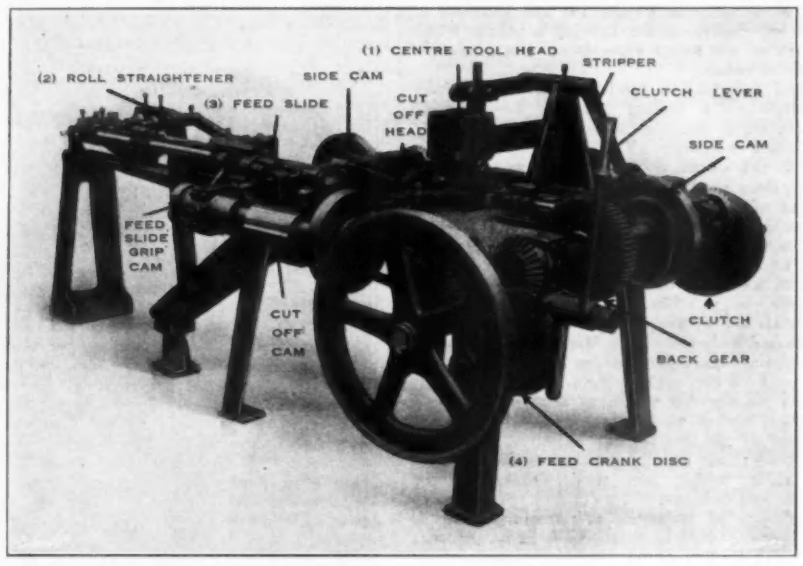

FIG. 9—FOUR-SLIDE WIRE-FORMING MACHINE—JAMES WARD

the straightener 2, and into the gripping dies in the feeding slide 3. A turn or so of the fly-wheel then draws the wire into position and the clutch is let in, thereby starting the machine.

The first half of the revolution is taken up by feeding the required length of wire. A crank disc 4 with an adjustable slide actuates through a steel connecting-rod a lever linked to the feeding slide and thereby moving the feeding slide backwards and forwards, the wire being gripped on the forward stroke and released on the return stroke, and the wire is thus fed forward.

The mechanism which grips and releases the wire is illustrated by the drawing in the upper part of Fig. 10.

The wire passes through two hardened steel jaws, one fixed 5, the other 6 free to slide. The gripping cam 7 lifts a hardened steel lever 8, causing the free gripping jaw to grip the wire at the instant the feeding slide moves forward. A spring 9 of heavy section provides a cushion between the jaw and the lever, and the moving gripping jaw is kept clear of the wire on the return stroke by spring action. Adjustment for a reasonable difference of wire gauges is provided for by the set screw 10.

Immediately on completion of the feed, the wire is released and in order to ensure dead accurate lengths the wire is gripped by a separate mechanism to prevent any possibility of the wire dragging back.

The lower drawing in Fig. 10 illustrates the mechanism and is self-expalanatory. Two separate cams 11, each with a "dwell" of less than 180 deg., are fitted to facilitate setting and to grip and release the wire instantaneously at the correct time. After being fed forwards the wire passes through the cut-off bracket, the cut-off dies being a combination of a tunnel die and shear.

The tunnel die is fixed in the cut-off bracket, and the shear blade mounted on a slide which is actuated through a lever from a wide cam on the cam shaft, and the slide is returned by a spring in the smaller size machine, whilst in the larger machine two levers actuate it, one moving it forward, the other returning it and ensuring a positive action.

The cut-off bracket is arranged so that it can be adjusted along the bed. In this manner the wire is positioned in relation to the central forming tool. The wire has now reached a position between the central tool and the front forming slide, the free end of the wire having entered an adjustable "Vee" guide, which, if there has been any sag in the wire, corrects it to the wire line. This completes the first half revolution, and the front forming slide now moves forward and bends the wire round the central forming tool. Next the two side slides simultaneously move forward, and, thirdly, the back slide moves up and completes the forming operation. The four slides move backwards and the stripper quickly ejects the completed form through a hole in the bed of the machine, and the cycle of operation is completed.

Several factors, such as gauge, length of wire, &c., determine the output of the machines, which varies between 250 and 50 finished products per minute. Several attachments can be fitted which will complete

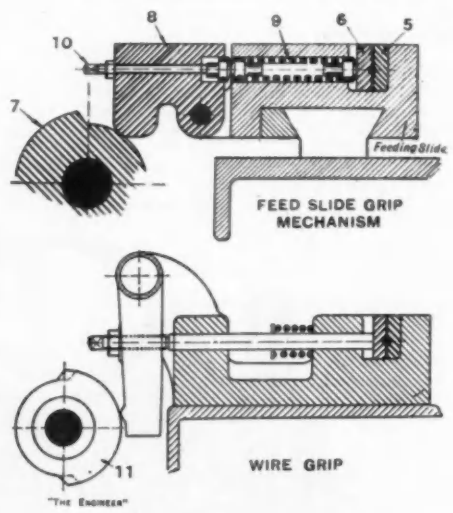

FIG. 10

an article whilst passing once through the machine. Amongst these are milling, punching, and piercing, &c. The machine is controlled by a clutch, the lever being within easy reach of the operator.

For most forming jobs the wire will be straightened enough by passing it through the roll straightener, but, if desired, a rotary straightener can be fitted, and since the wire moves forward intermittently, the rotary straightener is mounted on a suitable slideway, and is connected to the feeding slide lever in such a manner that when the wire moves forward the straightener also moves forward, but at a slower speed and also backwards during the return stroke of the feeding slide.

In this manner the straightening pegs are never actually rotating over a stationary piece of wire, otherwise the wire would break.

The rotary straightener should be fitted when the length of feed is large and the wire of small diameter.

(To be continued.)

Railway and Road Matters.

THE catenary wires used in the now abandoned overhead electrical equipment on the Southern Railway are being taken down on the South London section. It has already been done between London Bridge and South Bermondsey.

THE London and North-Eastern Railway Company is offering a first prize of £25 and a second prize of £15 for the design of (*a*) a first class or (*b*) a third class railway passenger compartment, in connection with the competition of industrial designs, organised by the Royal Society of Arts.

THAT the electrification by the London, Midland and Scottish and the London and North-Eastern companies' jointly owned Manchester South Junction and Altrincham Railway is about to be begun is indicated by the modifications that have been necessary in the morning and evening train services to allow for the speed restrictions called for by the engineering department.

IT is officially announced that the last stage in the electrification scheme of the Southern Railway will be opened on Sunday and Monday, March 3rd and 4th. It will cover the completion of the substitution of third-rail operation for the original overhead equipment, and entirely new electrical services between Wimbledon and Streatham Junction, Streatham Junction and Epsom, and the Norwood Fork to Beckenham Junction.

THE railways of the United States have, for some years now, done very good service to themselves and at the same time to the Press by the issue of a periodical known as *Railway Data*. Their example has now been followed by the British railways in the form of a monthly pamphlet called the *Railway Newsletter*. No. 2, for February, now lies before us. It contains several instructive short articles and various little-known facts about the railways.

IT is announced that Mr. A. C. Gardner, the docks engineer for Grimsby and Immingham, London and North-Eastern Railway, has been selected to fill the post of engineer of the Clyde Navigation Trust. Until Mr. Gardner became the docks engneer to the Great Central Railway at the beginning of 1918, he was mainly engaged on bridgework, and one big work for which he was responsble under the late Sir James Ball was the Scherzer rolling lift bridge over the Trent Navigation at Keadby.

THE report of Colonel A. C. Trench to the Ministry of Transport on the train accident in the tunnel adjoining the high-level station at Queen-street, Glasgow, on October 12th, was issued a few days ago. Three passengers were killed and fifty-two injured. Colonel Trench came to the conclusion that the driver of the Edinburgh train did not realise that he was slipping back. Pointing out that it was perhaps little realised how easy it was to be mistaken as to the direction of movement of a train in the dark, Colonel Trench said that, under the adverse conditions, he did not think serious blame could be attributed to the driver. The main responsibility must rest upon Signalman James Gray, who had nullified the special arrangement designed to provide an additional safeguard against a train slipping back by allowing the Alloa train to draw forward. It was probable, Colonel Trench added, that the anxiety to facilitate traffic was a genuine one.

IT is fairly certain that automatic train control will be recommended, and possibly pressed, as a result of the fatal collision of January 8th at Ashchurch. If that be so, the recommendation will be based on the need for some plan of advising drivers in foggy weather as to the condition of the signals they are passing. It is somewhat remarkable that not until the Ais Gill collision of September 2nd, 1913, was automatic train control, as now understood, recommended in an accident report. It is true that Sir Arthur Yorke mentioned that safeguard in his report on the Slough collision of June 16th, 1900, but only to condemn it. On the other hand, going back only to the year 1890, there were up to the Ais Gill collision no less than twelve collisions in fog, in connection with which cab signals or their equivalent were recommended. The last such recommendation was made by the late Colonel von Donop, in his report on the collision of November 24th, 1906, at Ulleskelf. Thereafter, cab signalling, which was actually what the Board of Trade inspectors wished for, was dropped and automatic train control recommended. That was done rather hesitatingly in Sir John Pringle's report on Ais Gill, but a memorandum signed by the three inspecting officers in November, 1913, was more emphatic. The late Major Druitt, however, in his report on the Wigan collision of December 19th, 1916, was the first officer definitely to advocate automatic train control.

WHAT may be called the Doe Hill fatal collision of February 12th was inquired into by Colonel E. P. Anderson on February 15th. The evidence was given in private, but from a statement made in public by Mr. Byrom, the chief general superintendent, London, Midland and Scottish Railway, coupled with some local knowledge, we are able to recite the conditions surrounding the accident. The Erewash Valley main line of the former Midland Railway runs from Trent to Clay Cross, and 3 miles south of the latter station is a signal-box known as Morton Sidings. At that point there are four lines of way—two passenger and two goods lines—and the outermost are the down passenger on the west and the up goods on the east. An express goods train from Sheffield to Birmingham was proceeding on the up goods line, but as a coal train occupied the line in advance, it was decided to pull up the express goods at Morton Sidings box and to back it by a through road from off the up goods on to the down passenger, and there to again reverse it and cross it by the slip points in the through road on to the up passenger line, whence it would proceed southwards and pass the coal train. For some reason or other, which has yet to be made public, the express goods train resumed its journey, but on the down passenger line! It ran through Doe Hill Station, and about that time some of the trainmen—we believe the guard—saw the error, and the train was stopped, but not in time to prevent the down Scottish express running head-on into it. The driver and firemen of the goods train were running to warn the express and so escaped injury. The coroner's inquest was opened on the 14th, and adjourned indefinitely.

Notes and Memoranda.

A DISCOVERY by which rubber can be protected from the destructive effects of the oxygen in the air has, it is claimed, been made. It is the oxygen which causes the decay of rubber goods. A substance which has been called neozone, is now mixed with the rubber, and is said to cause the goods made with it to last almost indefinitely.

A REPORT from Stockholm states that at the Graengesberg and several other Swedish mines experiments are being made with the working of drills at a much higher pressure than usual. By means of a special air compressor, manufactured by Aktiebolaget Atlas-Diesel at Stockholm, the pressure is raised from the usual 6 kilos. to 7 kilos. to 20 kilos. per square centimetre. So far, the trials are said to have yielded very good results, penetration with a pressure of 15 kilos. being increased to half a metre a minute, or twice as much as with ordinary pressure.

ACCORDING to Herr W. Keller, systematic experiments have proved that steel containing 0·60 to 0·70 per cent.—in exceptional cases even 0·77 per cent.—of tin can be rolled into sheets without cracking at the edges. The most unfavourable influence of the presence of tin is shown when welding such steel. The steel stood the cold-bending test up to a tin content of 0·60 per cent. The forging quality was only materially affected when the tin content reached 0·80 per cent. Whether the tin affected the quality of hard steel differently from that of mild steel could not be established.

THE French Ministry of Posts and Telegraphs has arranged for the installation of a high-power broadcasting station at Strasbourg. If the new station is approved by the Chamber of Deputies in the Senate, the allowance made for its construction and equipment is expected to be in the neighbourhood of 3½ million francs. A regular service will be guaranteed to both the French provinces Alsace and Lorraine, and all announcements will be made both in French and in German. The new station, if approved, will probably be in operation some time about January 1st, 1930, or soon after that date.

THE number of furnaces in blast in this country at the end of January was 139, a net increase of seven since the beginning of the month, eight furnaces having been blown in and one having ceased operations during the month. The production of pig iron in January amounted to 563,900 tons compared with 540,400 tons in December and 560,500 tons in January, 1928. The production included 185,500 tons of hematite, 226,700 tons of basic, 101,600 tons of foundry and 23,900 tons of forge pig iron. Production of steel ingots and castings in January amounted to 761,600 tons compared with 683,100 tons in December, and 626,200 tons in January, 1928.

A NEW line of equipment for the drying and purifing of various gases under pressure and for the conditioning of air is announced by the Silica Gel Corporation, Garrett Building, Baltimore. In general, the equipment includes duplicate absorbers packed with silica gel for removing moisture and contaminating lubricant from the gas compressor as well as undesirable impurities from such gases as carbon dioxide. An air heater is provided and from it hot air may be circulated through an absorber requiring regeneration for the purpose of driving moisture and impurities from the gel. In some installations coolers are also provided. This equipment requires no refrigeration for drying the air and needs only cooling water for providing the requisite cooling.

AN account of recent developments in the manufacture of solid carbon dioxide—"dry ice"—by the Dry Ice Corporation is given by H. E. Howe in *Industrial and Engineering Chemistry*. A new plant has been erected at the common boundaries of the cities of Elizabeth and Newark, New Jersey. It consists of three units, and is believed to be the largest plant at present in existence devoted to the manufacture of carbon dioxide. Research and development work have made possible the conversion of from 40 to 50 per cent. of the carbon dioxide from a liquid to a solid in one cycle. There is some loss of gas in opening the expansion chambers and in shovelling out the snow to form blocks. Normally these blocks are approximately 10in. by 10in. by 10in., and weigh about 40 lb.

WELDERS who have had some difficulty in getting sound deposits when attempting bronze welds on cast iron or steel will be interested in a suggestion received from an operator who has had not only a lot of experience, but also a lot of success. According to the *Welding Journal, U.S.A.*, he avoids flat welding positions as far as possible, arranging his set-up so that the line of weld is on an incline, and working it up from the bottom. In this way he avoids having the molten bronze run over on metal which is not hot enough to alloy with it, and then having to melt through this layer of bronze in order to bring the parent metal up to the welding heat, with the danger of burning out the zinc. With a little practice this method also makes possible shape welding without the use of moulds.

IN a lecture before the Chemical Engineering Group of the Society of Chemical Industry, Professor B. P. Haigh recently stated that it was a well-known fact that parts of structures and machines might break in a brittle way if a moderate load—often much smaller than may have been applied in static tests or in brief overload or overspeed tests—was applied and removed or reversed continually. This mode of brittle fracture, following long-continued repetition of stress, was described as "mechanical fatigue." Different authorities had stated that 90 per cent. of the fractures that resulted in breakdowns in service were attributable to fatigue; and although that proportion might perhaps be overstated, there was no doubt that fatigue cracking was, in fact, one of the most common causes of fracture in service. The Professor reviewed and discussed a wide variety of tests and experiments, with alternating and pulsating stresses, to illustrate and contrast the conditions in which fatigue cracking may be a source of danger. It was shown that the relation between fatigue strength and yield strength of mild steel was such that fatigue cracking was necessarily uncommon in mild steel in practical experience with ordinary conditions of loading. In high-tensile steels the relation between the two kinds of strength was often such that fatigue cracking was more frequent.

Miscellanea.

THE United States Bureau of Standards has practically completed a determination of the melting point of nickel, based upon two samples prepared in its own laboratories. The average value obtained was 1454·9 deg. Cent., as against 1452 deg. Cent., the value hitherto generally accepted.

THE Petroleum Department of the Board of Trade has been transferred to the offices of the Mines Department, Dean Stanley street, Westminster, S.W. 1. Mr. H. W. Cole, C.B.E., has been appointed Director of the Petroleum Department in succession to Mr. J. J. Wills, now Comptroller of the Companies Department. Mr. Cole will continue to hold his present post as Assistant Under-Secretary for Mines.

THE Blue Star Line announces that experiments with pulverised fuel in the liner "Stuartstar" have been so satisfactory that the other units of the company's fleet are to be equipped with a pulverised fuel system. The "Stuartstar" is at present on a voyage to South America. On her return she will be equipped to burn powdered coal entirely. She will then be the first steamer to run completely on powdered coal blown into the furnaces.

THE retirement is announced of Mr. R. Dumas, works manager at Rugby for the British Thomson-Houston Company, Ltd., a position he has filled since 1908. Mr. R. C. Clinker, chief of the engineering laboratory, has also relinquished his position, and is succeeded by Mr. H. W. Warren. Mr. Clinker joined the company in 1895 in London, and Mr. Warren joined the Rugby staff in 1911, and in 1913 went to Coventry. He was responsible for the introduction of insulation manufacture at both Rugby and Coventry.

MICROPHONES, amplifiers, and loud speakers have been installed in the German Reichstag in order to strengthen the voices of speakers, especially, it is understood, on those occasions when speakers are subjected to interruption and the House is generally suffering from noise created by opposing parties. When necessary it will be possible so to increase the amplification that the voice of the President can be made to dominate the tumult. At present there is not much demand in Germany for the speeches in the Reichstag to be publicly broadcast.

THE first general meeting of the Baird Television Development Company, about which questions were recently asked in the House of Commons, was held a few days ago. Sir Edward Manville presided. According to Sir Edward, interesting developments are in sight. A number of continental broadcasting stations have already installed Baird television apparatus, and he was asked if any apparatus had been installed in any British station. Sir Edward's reply was that he was not prepared to go at the moment one step farther than the replies to questions in the House of Commons.

ACCORDING to a contemporary, the cargo steamer "Castlemoor," of London, belonging to Messrs. Walter Runciman and Co., which was extensively damaged by fire off Western Australia in August last, is in the Central Dry Dock at West Hartlepool undergoing survey. The outbreak of fire lasted sixteen days, and the vessel had to be beached, temporary repairs being effected at Albany. The repairing of the vessel, it is estimated, will cost about £30,000. The "Castlemoor," which was built by Doxford's, of Sunderland, is a vessel of 10,800 tons deadweight. Her registered tonnage is 6574 tons.

WE understand that attempts to repudiate the national wages agreement for the engineering industry will be made at a special conference of executives to be held to-day—Friday, February 22nd—in London. The conference will discuss a report dealing with the condition of the industry and the desirability or otherwise of substituting sectional for national wages negotiations. The comparative prosperity of the motoring and electrical section is responsible for the move. There is, however, a sharp division of opinion among the leaders as to the wisdom of departing from national negotiations and standards.

EVIDENCE of continued progress is contained in the report of the consulting engineer to the Electricity Committee of the Stretford Urban District Council. In regard to the Barton-Urmston supply, distributor cables of a total length of about 1200 yards were laid during December, and the total length laid up to December 31st was 32,116 yards. The total number of applications received for supply was 930, and 820 services had been completed. Owing to the large number of applications received, the original scheme has been extended by about 30 per cent., and mains have been laid in a number of new streets which were not included in the original scheme.

WITH the object of improving facilities for handling the increasing import traffic of the port of Sunderland, the River Weir Commissioners have recently installed four new 5-ton electric cranes, supplied by Babcock and Wilcox, Ltd. These cranes, which have a radius of 47ft., are fitted with the makers' level luffing jib. Three additional 3-ton electric cranes have also been installed at the East Quay. Another interesting scheme which has been put in hand by the Commissioners is the conversion of Roker Pier lighthouse, one of the best-known lights of the North-East Coast, to electric lighting, automatically operated. The fog siren, which is also situated in the lighthouse, is also to be worked automatically by electricity.

A PROGRAMME initiated by the President of the State of Rio de Janeiro has been sanctioned to make Nictheroy—the commercial capital of Brazil—a principal port of call for Transatlantic steamers. The work, which has been contracted for with a French engineering firm and is being financed by a French bank, will comprise a substantial amount of land reclamation; the extension of quays and the installation of modern electrical apparatus to handle the growing shipments of coffee, &c., to the United States and Europe. The electric street railway will be extended to the outlying districts, where several white-sand beaches—praias—are found. It is also proposed to conclude contracts for the extension of the water and sanitary works, for which purpose a loan of 6,000,000 dollars, say, £1,200,000, has been offered by United States financiers.

COMPRESSORS FOR REFRIGERATION ON SHIPBOARD

(*For description see page* 217)

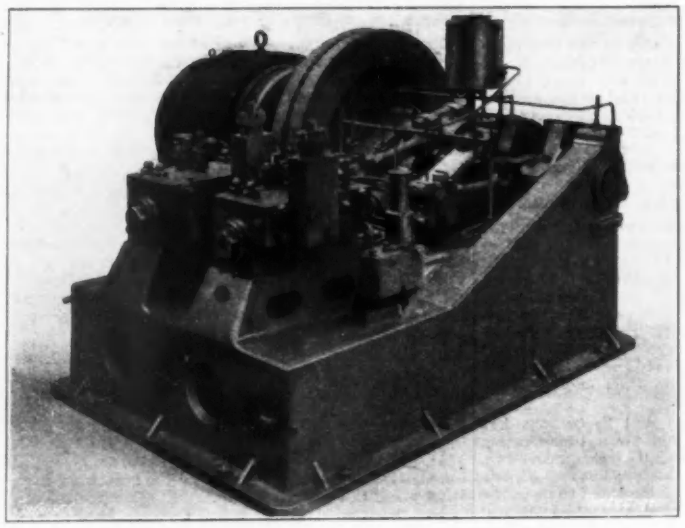

FIG. 8—ELECTRICALLY-DRIVEN HORIZONTAL CO_2 COMPRESSOR

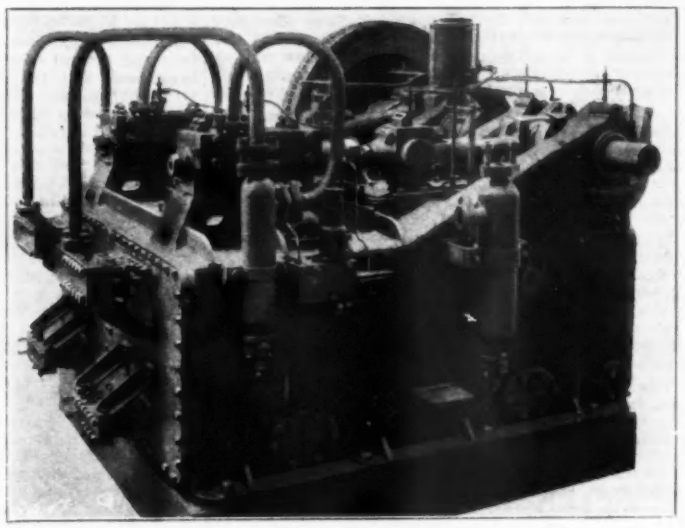

FIG. 9—CO_2 COMPRESSOR FOR LIMITED DECK SPACE

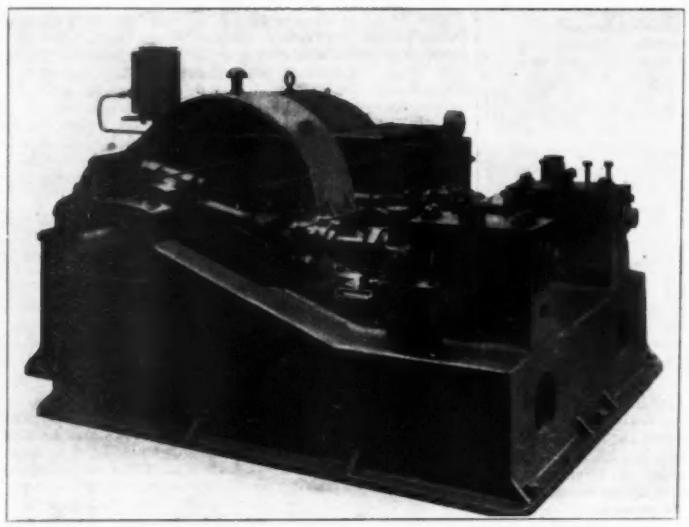

FIG. 10—COMPRESSOR WITH DOUBLE HELICAL REDUCTION GEAR

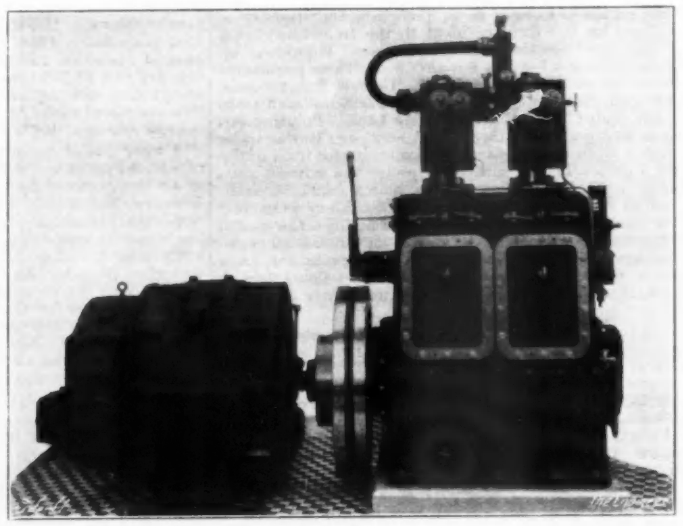

FIG. 11—ENCLOSED TWIN-COMPRESSOR CO_2 MACHINE

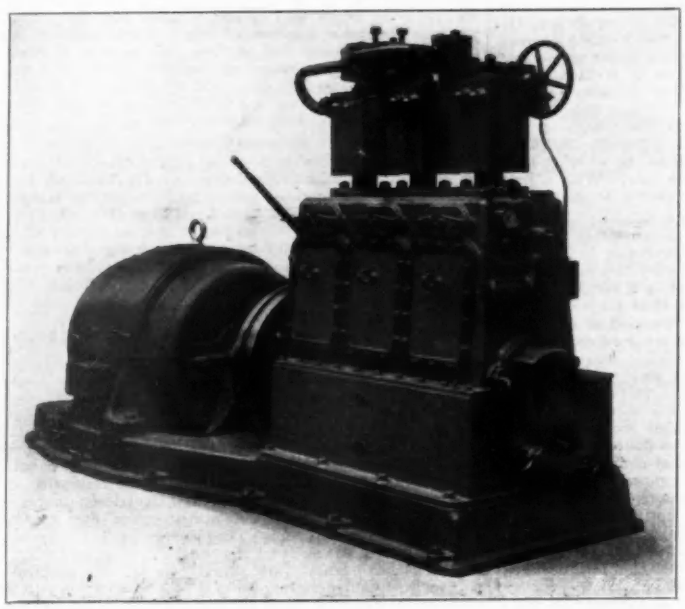

FIG. 12—THREE-COMPRESSOR CO_2 MACHINE

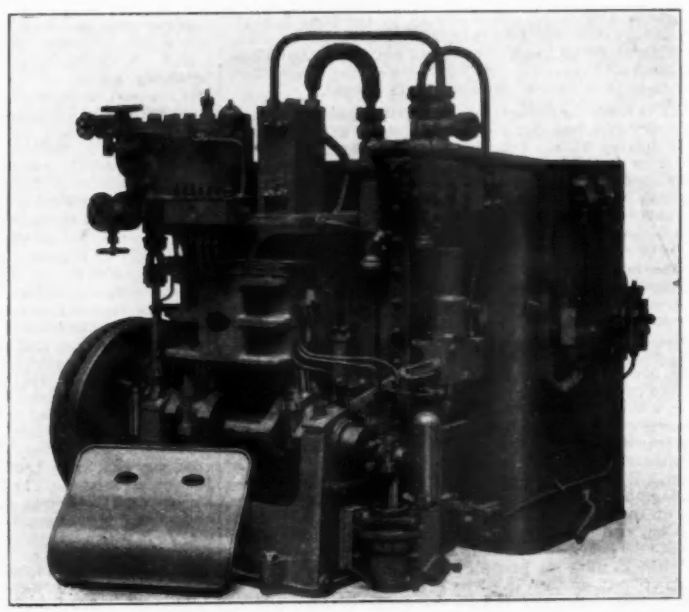

FIG. 13—SMALL STEAM-DRIVEN VERTICAL CO_2 COMPRESSOR

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THE ENGINEER.

FEBRUARY 22, 1929.

The Melchett-Turner Scheme.

WITH one accord the lay Press has fallen upon the engineering employers because of their attitude to the Melchett-Turner scheme. Even *The Times*, the most reasonable and careful of our newspapers, wrote of the memorandum of the British Engineers' Association in terms which cannot have failed to suggest direct "inspiration" and which were reflected with more reserve and restraint in the special weekly trade and engineering supplement of that great paper. If we may venture to say as much to our daily contemporaries, we would ask them to consider if it is not possible that the representatives of the great engineering industries of the kingdom really do know their own business best. There is no question here of the irresponsible and hasty utterances of insignificant parties. Both the B.E.A. and the F.B.I. are bodies which include in their membership engineering employers of the highest standing in the land. Nor have their actions been taken without profound consideration. The charges that have been levelled against them, charges of bull-headedness, of narrow-mindedness, and an "ugly suspicion of temper" are manifestly absurd. A single individual or a small group of individuals may display temper, but an influential organisation like the B.E.A. is in a very different position. What it says publicly must first be approved by a Council, and one may be confident that where many wise heads are gathered together temper will not be allowed to prevail. The mistake which the B.E.A. made, a mistake which was diplomatic and nothing more, was that it was too categorical. It said perfectly clearly what it meant. It did not cloud its words; it spoke straight out and for the first time the daily Press saw in all their nakedness the objections to the scheme. The Grand Council of the F.B.I. was more discreet. It hesitated a doubt instead of declaring it with trumpets, and whilst it closed one door it opened another "for further discussion." Thus does the gentle employer soften the disappointment of the applicant with "I am sorry I have no post to offer you to-day, but I shall be happy to bear your name in mind."

Whilst it is true that the engineering industry has, during its long existence, suffered excessively from disputes with labour, it is equally true that there is none in which more agreements have been signed, and none in which they have more frequently failed. But through a succession of troubles, mutual understanding has been attained, and we do not hesitate to say that at this time there is no great industry in which employers and employed are in greater sympathy. The managers of engineering concerns are practically unanimous in the view that, by comparison with workers in the sheltered trades, mechanics are badly paid. But the industry is not able to pay more at the present time. The position has been explained in detail to representatives of labour, and for the past three difficult years the workpeople have recognised that fact and have loyally accepted its consequences. The machinery of negotiation has worked well and smoothly. To change it at this moment would be to invite trouble; to open any new avenue for discussion or debate would be to imperil the peaceful relations which now exist. The policy of the employers is to leave well alone, and all who are intimately acquainted with the difficulties and anxieties through which they are passing will not blame them for that conservative attitude. Many of the daily papers have written as if the engineering employers were standing deliberately in the way of progress. Nothing could be further from the real fact. We say without the slightest fear of challenge that there is no more enlightened industry than that of engineering. It has led the way in the adoption of modernised systems of paying wages by results, it has made ample provision for the recreation of its employees, it attends to the education of apprentices and has improved the amenities of shop life as far as possible within the conditions which the nature of the work imposes. It has adopted conciliation schemes and has done much to disperse that lack of trust and confidence which at one time was the root of so much trouble. In view of all this, to speak of the engineering industry as though it were reactionary is as ridiculous as to suggest that it is not sympathetic with the popular movement to bring the workers into closer touch with the problems of management. But engineering employers, as a whole, know their men and the minds of their men as fully as the leaders of any industry, and more fully than most. They are under no illusions; they know perfectly well that no more than a very small section of the men care a brass button about the problems of management, and are quite content to leave them to their employers. Indeed, they are no more qualified to express useful views on the great industrial problems of the day than the average professional man is on the problems of banking. It may be desirable, it might be profitable, to encourage such an interest, but at the present time the views that would be expressed would be those of labour leaders and industrial philosophers with a political bias. They would not represent the attitude of labour as a whole. The employers see a danger there. They see a possibility of the disturbance of tranquil conditions, and they do not see what useful results can ensue.

It must not be inferred from the refusal of the Federation of British Industries and the National Confederation of Employers organisations that engineering employers are unsympathetic to the general principles underlying the Melchett-Turner scheme. Far from it. The clause in their letter to the General Council of the Trades Union Congress expresses their attitude accurately. Let us quote it. "Throughout the consideration of the whole matter the Confederation and the Federation have been conscious of the importance of doing everything in their power to further the promotion of industrial peace in British industry, and the cordial invitation extended to your General Council to meet representatives of the Confederation and of the Federation is made in the hope that the discussion will be such as to help forward a better mutual understanding in industry generally." We may leave the matter at that point for the present.

The British Industries Fair and Engineers.

THE great annual trade fair which opened at Birmingham and London on Monday last is only in part representative of British industries. There

are many notable omissions. The great transport industries are represented only by minor exhibits; the larger products of marine engineering, aeronautical engineering, locomotive and railway engineering are not exhibited in any worthy form; the motor industry has its own exhibitions for pleasure and commercial vehicles, and makes no display; the machine tool builders are debarred from participation by the regulations of their Association; the engineering of great steam and hydraulic power plants is barely represented, and structural engineering and the heavier branches of the steel trade are not prominent. In these respects the B.I.F. is in marked contrast with the great international Fair at Leipzig, where the heaviest classes of engineering work are always conspicuous objects. But despite these limitations, the branch of the Fair at Birmingham is a wonderful display. After all, it is probable that the major portion of our trade lies in the sale of what we may call without any disrespect "cross-the-counter goods"—goods, that is, that may be made in quantity and sold from stock. It is this class of products that forms the bulk of the exhibits at Birmingham, and of them it may be said that they are reasonably representative of the industries of the country, although Midland firms predominate by a very large majority.

Last week we devoted to the Fair a special illustrated Supplement, and to-day we give another of rather larger dimensions. The preparation of special numbers is an unnecessarily anxious matter, and we desire to say a few very plain words to manufacturers with regard to them. Several weeks ago, immediately the list of the exhibitors was available, we posted something like a hundred and fifty letters inviting manufacturers to send us particulars and illustrations of their exhibits. The response was, as usual, disheartening. Very few firms took the trouble to reply at all; still fewer gave us the information required. A second batch of letters, almost as large as the first, was posted, and material began to dribble in. But how carelessly prepared! With what little attention to the advantages of publication which we offered! Many firms sent their catalogues with the brief remark that the exhibits would be drawn from the products shown in them. Others sent indifferent illustrations, and still worse descriptive text. Still more letters had to follow, asking for fuller details, for better illustrations, or for explanations of matters which had been left vague. At the end of three weeks enough material had been "scraped" together—we use the word advisedly—to fill the first special Supplement and more correspondence and individual visits had to be undertaken to collect enough for the second. That manufacturers should display such indifference to their own manifest interests shows only too clearly how well justified were the words which the Prince of Wales used on the subject of salesmanship on Monday evening. We may say without boasting that THE ENGINEER goes to every corner of the civilised globe, and that it is read, or at least looked at, every week by thousands of potential customers. Surely, one would have thought that manufacturers would hasten to avail themselves of the publicity we offered to them. It would be natural to expect that instead of having to be urged to provide material they would hasten to supply it; that their representatives would be waiting on us begging for space rather than that we should have to wait upon them, and in the end only extract suitable matter with difficulty. That there may be no shadow of doubt, let us say quite distinctly that we asked for no *quid pro quo* of any kind or of any form. Our sole object was to do the best for British trade, and we offered exhibitors the freedom of our pages with no more reserve than was imposed by a reasonable restriction of space. We have, we must admit, grown somewhat hardened to this sort of indifference, but we did hope that this year, when it is imperative that every effort should be made to encourage British trade, our efforts would be met with a greater measure of encouragement. May we say very earnestly to our engineering manufacturers that they are guilty of neglecting a very valuable branch of salesmanship when they fail to make use of the services offered to them by their technical Press. To them, certainly not less than to other industrialists, the words of the Prince should have great weight. They still fail to appreciate the enormous value of propaganda. In our recent Retrospect of 1928 we referred to the almost complete absence of foreign propaganda, and we mentioned that on but one occasion had we been asked to make a reprint in a foreign language. The Prince very rightly urged the necessity of speaking to foreign purchasers in their own tongue. It is not sufficient—though it is better than nothing—to circulate foreign catalogues. The catalogue does not create an atmosphere, and it is an atmosphere that is wanted. Descriptive articles can do that. Let us record but a single example. Some months ago we described fully a novel steam plant. The very day upon which our article appeared the manufacturers received an inquiry, as a result of it, and in due course an order valued at many thousands of pounds was placed with them. No ordinary catalogue could have achieved that object, and, indeed, it is highly improbable that a catalogue would ever have reached the potential customer. The Press distributes information broadcast, and inevitably much of it reaches quarters that are untouched by the circulation of catalogues. Moreover, it gives information and particulars which excite the interest, and may lead to inquiries which the more or less trite pages of a catalogue would not elicit. We have noticed that foreign firms devote far more attention to this branch of salesmanship than British firms. They have not failed to appreciate the enormous value of propaganda, and they spend a great deal of money on the careful preparation of material and upon its circulation in foreign tongues.

We have spoken very plainly to our brother engineers, and we hope without offence. We do not pretend to know their business better than they know it themselves. But on the subject of publicity we may, we hope, venture to claim that we are on our own ground, and therefore in a position to offer useful advice. The Fair will be visited by many thousands of possible purchasers, and we do not for one moment say that anything else can be as good as a personal inspection of exhibits and conversation with manufacturers. But we would ask engineers to remember that there are thousands of engineers who will find it impossible to visit the Fair, and that there are many who will desire to have a printed record of the exhibits they have seen. To all these, publication in the Press is valuable or convenient. Finally let us say that we do not complain of the quite unnecessary work that the preparation of special descriptions of the Fair has entailed, but we are disappointed to find British engineering manufacturers indifferent to their own interests, and we earnestly hope that a greater readiness to make use of the advantages which we offer will be shown in connection with future Fairs and Exhibitions.

The Bursting of Water Mains.

DURING the last few weeks there have been numerous reports of the bursting of water mains in London. In several instances much damage has been done; large areas of wood pavement have been forced up and disintegrated, cellars have been flooded, and property injured. In all cases there has been more or less considerable inconvenience to consumers, and the cost of reinstatement of mains and road surfaces will undoubtedly prove to be heavy, while loss has been sustained by the escape of large volumes of water on which no small amount of money in procuring, treating and pumping had been expended. The mains that have burst have not always been those conveying water for domestic purposes; some have been those charged with water at high pressure for the operation of such things as hydraulic lifts. Always, however, the results have been more or less of the same order, and it has occasionally been necessary to close the whole width of a street whilst repairs were being effected. It is not to be wondered at, therefore, that some such questions as "What causes these burstings?" and "Cannot something be done to prevent them?" are asked. Such happenings, as we have said, cost money, and, in the long run, the loss is bound to be borne by the community—at any rate that is so where the mains affected are those belonging to the Metropolitan Water Board—and the community does not, of course, want to pay more for its water than is absolutely necessary. Nor does it relish the possibility of having its water cut off for an indefinite period.

In the circumstances, it is natural that the Metropolitan Water Board should concern itself with the matter. The duty of maintaining supplies falls upon the Works and Stores Committee of that body, and certain pronouncements recently made to the Board by that Committee are worth referring to. In the first place it will, we fancy, come as a surprise to most people that "The recent cases of burst mains . . . are not excessive, nor indeed are they above the average number occurring at this time of year." This statement, seeing the source from which it comes, must be accepted as true, but if the numbers of bursts have not been above the average, the effects must surely have been more serious than those experienced in past years. Certainly, they have attracted a great deal more attention. Leaving the question of numbers aside, however, more importance attaches to the causes of the accidents. According to the Committee: "Fractures of mains are caused by a variety of circumstances including (i.) changes of temperature; (ii.) traffic conditions; (iii.) interference with the support of the mains during road operations or by other works; and (iv.) deterioration of the iron of the pipe by the surrounding soil." Cast iron mains, the Committee explains, are fractured during very cold weather by the admission of water at low temperature from exposed filter beds to mains lying in the ground at a temperature several degrees higher than that of the water entering the mains. That fractures under such conditions are due to temperature effects is, says the Committee, made manifest by the fact that they are more frequent in that part of the Board's area where some of the older mains are jointed with iron borings and sal ammoniac. Pipes so jointed constitute a practically continuous length of main, which must expand and contract as a whole with changes of temperature, and which has not the capacity for responding to such changes as is possessed by a lead-jointed main. Moreover, statistics of the severe frosts of 1925 and 1927 confirm the opinion that the numbers of bursts are fewer in those districts in which the water is derived from wells, and hence has a temperature much nearer to that in the mains than has water flowing from open filter beds. According to the Committee, however, the fractures of the larger mains which have occurred recently were not caused by temperature changes. Those following the Holborn explosion obviously cannot, it maintains, be attributed to them, and it goes on to state that in other breakages there was evidence in one case that the fracture was due to an interference with the original support of the main, whilst "another burst may be traced to the weight and vibration of road traffic." Fractures have in recent years been attributed with increasing frequency to the enhanced weight and speed of modern vehicles and to the vibrations set up by them. Enlarging on this point, the Committee remarks:—"It is notorious that the volume weight and speed of road traffic have vastly increased during recent years, and the reconstruction of many of the old roadways in the Board's area in an attempt to cope with this modern need has had a detrimental effect upon the mains laid under the streets. In many cases the camber of the carriageway has been lowered, thereby reducing the depth of the covering above the mains, and where this has occurred and a concrete road bed brought into contact with the main, damage has undoubtedly been done by direct transmission of weight and vibration." The Board has, in fact, expended in recent years many thousands of pounds in laying new mains at greater depths in streets in which the carriageways have been reconstructed.

It is obviously to the advantage of everyone that the cause or causes of these breakages should be definitely ascertained, so that measures may be taken to prevent their occurring. It is satisfactory to note, therefore, that, according to a statement of the Chairman of the Committee, a special subcommittee has been formed to investigate the question and to report upon it. There are several directions, in addition to those already indicated, in which, it appears to us, inquiries may be usefully directed. It will have been observed that, in the causes of fracture set out by the Committee, no mention is made of electrolysis as a cause of weakening of the metal of the mains. In these days of electric traction and of the use of buried electric mains stray currents are known to exist in the ground. Have they played their part in the trouble? Then again, is there an age at and beyond which the metal of pipe or joint becomes in the ordinary course of events, by some means or the other, weakened to such an extent that it is no longer capable of withstanding the pressures for which it was intended—and the possibly greater pressures set up by forcing through the mains larger volumes of water than those for which they were designed. The whole question is so complex and there are so many diverse factors that may or may not have a bearing upon it, that it will require most careful and critical examination. It is important that the inquiry should be thoroughly and scientifically carried out in order to establish beyond all shadow

of doubt the cause or causes of these fractures. It would only be a useless expenditure of labour and of money were the present inquiry to reach a conclusion which did not go right to the root of the matter.

The Electricity Commissioners' Eighth Annual Report.

THE eighth annual report of the Electricity Commissioners covering the year April, 1927, to March, 1928, has just been issued. The outstanding feature of this period was the adoption by the Central Electricity Board, with certain modifications, of the first two regional schemes prepared by the Electricity Commissioners under the Act of 1926 for the co-ordinated development of generation and main transmission in Central Scotland and South-East England respectively. By means of these and other regional schemes the new technical *régime* for the control of generation and development of main transmission will eventually extend to the country as a whole, although it is apparent that it can only be brought into operation by stages owing to the magnitude of the constructional works and the number of arrangements necessary for the carrying out and subsequent operation of the new schemes.

Under each scheme regional transmission lines and associated transforming stations for linking up the selected generating stations with one another and with the systems of authorised undertakers in the area will be constructed by the Central Electricity Board; arrangements will be made for the construction of such new generating stations as may be necessary and for the extension of existing selected stations, and a system will be developed by the Central Board for the collective operation of the selected stations under arrangements between the Board and the respective owners of the individual stations with the view of securing the best economies in generation. When a scheme also provides for the standardisation of frequency, the change over will be progressively carried out by the undertakers concerned in accordance with the requirements of the Central Board under a programme devised so as to avoid dislocation of supplies afforded to existing consumers or prevention of further development. In preparing the regional schemes the Commissioners have envisaged in each case that a period of some five years will be required for the construction of the main transmission system by the Central Board for the complete or partial standardisation of frequency where a change over is involved and for the bringing of the scheme into full operation. It is obvious that the full advantages cannot be expected to mature over the country as a whole for a number of years to come, even when allowance is made for the utmost expedition in construction, in the completion of all necessary arrangements and for the concurrent carrying out of schemes in different regions.

The returns referred to in the report bear evidence that there was a rapid recovery, as regards output and operating results, from the adverse effects of the prolonged coal strike in the preceding year. The output—units generated—showed an increase of nearly 18·7 per cent. on the figures for 1926–27, the larger output being obtained by an increase of only 5·4 per cent. in the amount of coal and coke consumed. The resumption of more normal conditions was also accompanied by a falling off in the use of oil fuel at generating stations, the consumption in 1927–28 amounting to 40,107 tons, as compared with 145,911 tons in 1926–27. Notwithstanding the restrictions on the industrial demand for power supplies and the retarding effect on the rate of growth of output caused by the fluctuating conditions of trade and industry during the past eight years, the preceding figures and those given in prior reports show that the production of electricity at the stations included within the scope of the returns has practically doubled since 1920–21. They also show that there has been an all-round increase in the neighbourhood of 54 per cent. in the amount of electricity produced per ton of coal and coke consumed for that purpose as compared with that experienced in practice in 1920–21.

The number of stations dealt with in the returns was the same as in the previous year, the closing down of twenty-three stations during the year being offset by the coming into operation of the same number of other stations on or after April 1st, 1927. There was an increase of about 19·6 per cent. in the sales of electricity by authorised undertakers as compared with the figures for 1926, and a total increase of about 88 per cent. during the five years since 1922. On the basis of the estimated total population of Great Britain at the end of 1927, namely, 44·18 million, the sales of electricity from public sources of supply in that year thus represented an average consumption of 155 units per head of population. Reference has been made in previous reports to the fact that the public supply stations in Great Britain represent a portion only of the total generating resources of the country; and that large additional supplies of electricity used in manufacturing and trading operations are derived from privately owned generating plant which has been installed on a widespread scale. The operations of private plant do not come within the scope of the statistical returns which the Commissioners are empowered to obtain under the Electricity (Supply) Acts, and no official records are available as to the annual consumption of electricity generated by such plant. A valuable indication of the extent of the electrical generating plant installed for industrial purposes in 1924 in factories and other works in Great Britain is however afforded by the preliminary reports on the third census of production, 1924, issued by the Board of Trade during the past year. The figures show that the industrial generating plant installed in 1924 amounted to about 2,564,000 kW, as compared with 3,943,000 kW in the case of authorised and non-statutory electricity undertakings supplying mainly for sale to the public. The generating resources of trade and industry in that year thus represented an addition of about 65 per cent. to the resources of electricity supply undertakings.

The preliminary reports do not embody particulars of the production of electricity in 1924 from the generating plant of industrial organisations, but indicate that the returns received by the Board of Trade under that heading will be summarised in an analysis of the final results of the census. It is apparent, however, from the preceding figures that the output of private generating plant represents a substantial addition to the annual consumption of electricity in Great Britain as measured by the returns of authorised undertakers only.

The aggregate capacity of the generating plant for new stations and extensions of existing stations sanctioned by the Commissioners during the year 1927–28 amounted to 668,357 kW. While the amount of plant sanctioned for new generating stations was greater than in the previous year, the amount sanctioned for extensions of existing stations was smaller by about 118,000 kW.

The proceedings on a number of applications relating to the extension of generating stations were affected by the fact that the stations were situated in areas within the ambit of regional schemes which had been transmitted to the Central Board or were in course of preparation by the Commissioners. Having regard to the provisions of Section 18 (2) of the Act of 1926, the Commissioners found it necessary to give special consideration to such applications, and in a number of instances a decision had not been arrived at by the end of the year under review.

During the year ending March 31st, 1928, the Commissioners issued consents—nine to authorised undertakers and six to non-statutory undertakings—in respect of the establishment of new generating stations representing the initial installation of plant having a total rated capacity of 246,642 kW.

Literature.

The Collected Scientific Papers of John James Waterston. Edited, with a biography, by J. S. HALDANE, M.D., LL.D., F.R.S. Edinburgh: Oliver and Boyd. 1928. Price 25s.

SAVE by a few physicists, who were first made acquainted with his work in 1892 when Lord Rayleigh salved from the archives of the Royal Society some of his rejected papers, Waterston is almost forgotten. He failed in his day to convince the scientific world, and his essays were allowed to lie in complete abeyance for some fifty years. A few of them were then recovered from oblivion, and justice was done to his name by those who studied them. Dr. Haldane has now gone a step further. and in this handsome volume has collected and edited more of his numerous and varied writings. He has, too, written an excellent biography of Waterston. It was greatly needed; in science as in literature, a knowledge of the personality of authors does not a little to keep the memory of them and of their works in the minds of men.

Waterston was born in Edinburgh in 1811. His father was a manufacturer of sealing-wax, and his mother came of the family of Sandeman, famous for those antithetical products, Sandemanianism and old port. She was a woman of great character and great ability. His father was something of a musician and took a sincere interest in science and literature. Hence it was in an intellectual atmosphere that J. J. Waterston and his eight brothers and sisters were brought up; but, if we may judge of the whole family from what we know of one, it was not overweighted by the appreciation of its own merits, and "could see a joke as well as you and laugh at it as such." Waterston's letters which Dr. Haldane has collected may be said to radiate happiness. His biographer seems to suggest that he was in reality a bitterly disappointed man and that, through force of character, he hid his chagrin from his friends; joking most when smarting most from the misunderstanding of his contemporaries. It may be so. But another view is not untenable. He was a true philosopher, and it is, at least, not inconceivable that the buffets of the world were no more able to disturb him than Diogenes or Socrates. He began writing at nineteen, when he attacked, with the temerity of youth, a mechanical explanation of gravity. A couple of years later he came to London—we have a delightful letter on his sea journey hither—and was entered as a pupil in civil engineering with Mr. James Walker. But he was too interested in science to tolerate the long hours of a busy office, and he took an easier job—under Government—which left him more leisure for the work to which he was devoted. An equally easy berth with much better pay then attracted him, and he went off to India to be Naval Instructor to the East India Company's Cadets. That was in 1839. It is interesting to note in passing that he knew nothing about naval architecture when the Board appointed him, but he taught himself enough for his duties during the long voyage in a sailing ship to Bombay, and he appears to have been both personally and professionally a success as a teacher—not impossibly because he knew how to temper dignity with humour. He spent years in India, and much of his work was done there. He was an anatomist and physiologist, as well as a civil engineer, mathematician, and physicist, and in 1845 published a work called "Thoughts on the Mental Functions," which Dr. Haldane has now rescued from the oblivion into which it immediately fell. His editor, who speaks with authority, tells us that "it is a very acute essay, far ahead of its time." The curious thing about it is that it seems to have led Waterston into quite other fields. He "saw clearly that the problems of life and conscious behaviour are bound up in those of molecular or atomic behaviour." He himself wrote: "In whatever way we examine the phenomena of nature, molecularity is the grand terminus to which all our investigations lead—to which all efforts or discoveries necessarily tend, and upon which they are now becoming more rapidly concentrated." Such materialistic views of the mental functions were repugnant to the period in which he lived, and it is possible that Waterston lacked the courage to pursue them Certain it is that he dropped the subject, whilst retaining the idea, and turned his intellect to the study of molecular physics, and particularly to the kinetic theory of gases and the nature of heat. It must be remembered that in the 'forties and 'fifties of last century the material theory of heat had not been entirely displaced. Caloric was still to many philosophers—even to Kelvin—a real substance, and many advanced thinkers of that period found it difficult to absorb the idea of heat "as a mode of motion." Waterston divorced himself from all that he had been taught, and in 1845 submitted a paper to the Royal Society, in which the molecular theory of gases was ably developed. It was called "The Physics of Media Composed of Free and Perfectly Elastic Molecules in a State of Motion." The same fate which had befallen his earlier paper engulfed it; it was wholly neglected until, as we have already noticed, Lord Rayleigh discovered it half a century later. It was not until some years after Waterston's paper had sunk in the archives of the Royal Society that the kinetic theory of gases was fully developed and accepted. It is only fair to his memory that the part he played—too early, as it happened—should be put on record, and we welcome, therefore, the care which Dr. Haldane has devoted to its presentation.

Waterston continued to write on philosophical questions, but even after his return from India he failed wholly, and strangely, to attract attention. This neglect does not appear to have soured him at all; he was always cheery, genial, and full of humour. The mystery of his death cannot, therefore, be associated with disappointment; nor was it connected with financial or other troubles. In 1883, when he was seventy-two, he left his lodgings in Gayfield-square, Edinburgh, for his usual morning walk, and never returned. It is assumed that he was overcome with giddiness and fell into the sea from the breakwater at Leith, but nothing positive is known.

We thank Dr. Haldane for giving us the excellent biography from which we have drawn, and for redeeming Waterston's papers from oblivion, and the author's memory from neglect.

BOOKS RECEIVED.

Managerial Profit-sharing. By C. Canby Balderston, London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 12s. 6d. net.

Zugfestigkeit und Härte bei Metallen. By Dr.-Ing. Otto Schwarz. Berlin: V.D.I.-Verlag G.m.b.H., Dorotheenstrasse 40. Price 5·40 marks.

Clubs, 1929. Edited by C. Austin-Leigh, M.A. London: C. Spottiswoode, Ballantyne and Co., Ltd., New Street-square, E.C. 4. Price 7s. 6d. net.

Report of the Fourth International Shipping Conference Held in London, June, 1928. London: The International Shipping Conference, 28, St. Mary Axe, E.C. 3.

Astronomy for Surveyors. By M. K. Rice-Oxley, A.C.G.I., and W. V. Shearer, B.Sc. London: Methuen and Co., Ltd,. 36, Essex-street, W.C. 2. Price 8s. 6d. net.

Report on the Trade and Commerce of East Africa. By C. Kemp. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 2s. net.

Transactions of the Manchester Association of Engineers, 1927–1928. Manchester: The Manchester Association of Engineers, St. John's-street Chambers, Deansgate.

Low-temperature Carbonisation (or Distillation) Explained. By Murray Stuart, D.Sc., &c. London: Mining Publications, Ltd., Salisbury House, E.C. 2. Price 4s. net.

Rolling Experiments on an Aerofoil of R.A.F. 32 Section. By H. B. Irving, B.Sc., and A. S. Batson, B.Sc. Being Reports and Memoranda No. 1182 (Ae. 346) of the Aeronautical Research Committee of the Air Ministry. Published by H.M. Stationery Office. Price 6d. net. 1928.

The Boirault Automatic Coupler.

AUTOMATIC couplers for railway rolling stock have been invented without end, but very few have reached the stage of practical trial, still less extensive adoption. The prime reason does not lie in the need for automatic couplers being less than the ardent band of coupling inventors is persuaded is the case. Nor does it lie in the difficulty of devising a coupler that will operate satisfactorily purely as a piece of mechanism. The trouble resides in the fact that most inventors overlook, or treat as being of secondary importance, certain features which a practicable form of coupler must possess in addition to its ability to couple and uncouple railway vehicles without requiring a man to enter the space between their ends.

Perhaps of prime importance among these frequently ignored features is the requirement that the coupler shall when fitted still permit the orthodox manual coupling gear to be brought into use without loss of time. Every of automatic coupling will be lost if a man is still required to go between the vehicles to connect the train pipes, &c.

Another essential requirement is that the coupler should be adaptable to existing rolling stock without modification of the draw gear and buffers already provided. It should, if possible, be capable of being fitted in a few minutes at most, to any vehicle while it is standing on the rails. It should in addition act as effectively when the vehicles to be coupled are standing on a curve as when they are standing on a straight portion of the line, and should permit them to be uncoupled with equal readiness in either condition. It is essential, too, that the coupler should not fail to act when the buffer heights of the two vehicles to be coupled differ by as much as 6in. or 8in. The pressure between the vehicles required to secure the action of the coupler should not be great, nor should the force which it is necessary to exert to effect the uncoupling. It has also to be borne in mind that during shunting operations the coupler will frequently be required to act in the uncoupled state as a buffer to push instead of draw the vehicles. Nor must it be forgotten that it is most undesirable that the use of the coupler should entail an increase in the distance between the ends of the coupled vehicles and therefore in the overall length of the train. Finally, the device should be simple in construction, positive and infallible in action, moderate in first cost, and economical in maintenance.

When this list of requirements, and others which might be added to it, is studied, we perceive that the design of an acceptable automatic coupler is far from being so simple as the mere mechanical results to be achieved would suggest.

The Boirault automatic coupler, which we illustrate herewith, is claimed to fulfil all the requirements we have indicated. It is a French invention, and has been adopted as standard equipment on the French State Railways, on which no fewer than 15,000 are now in use. Under the name of the B.A.W. coupler it is now being made in this country by Sir W. G. Armstrong, Whitworth and Co.

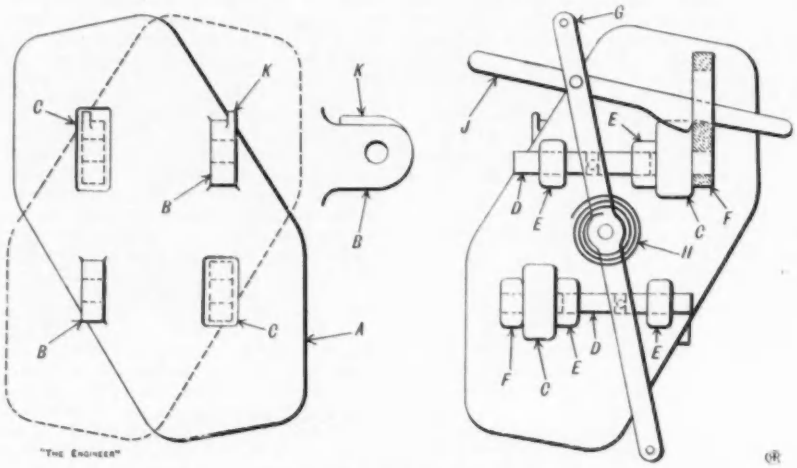


FIG. 1—DIAGRAMS OF BOIRAULT COUPLER

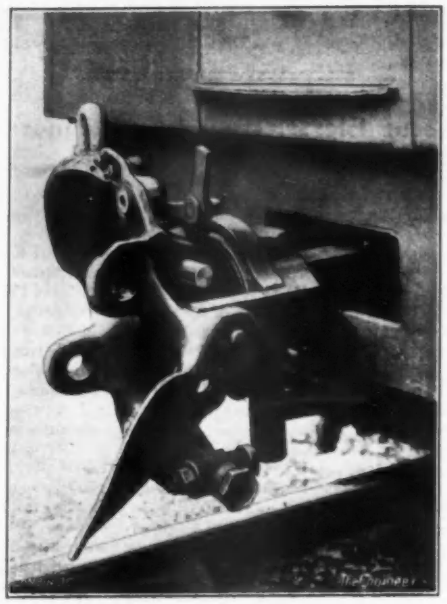
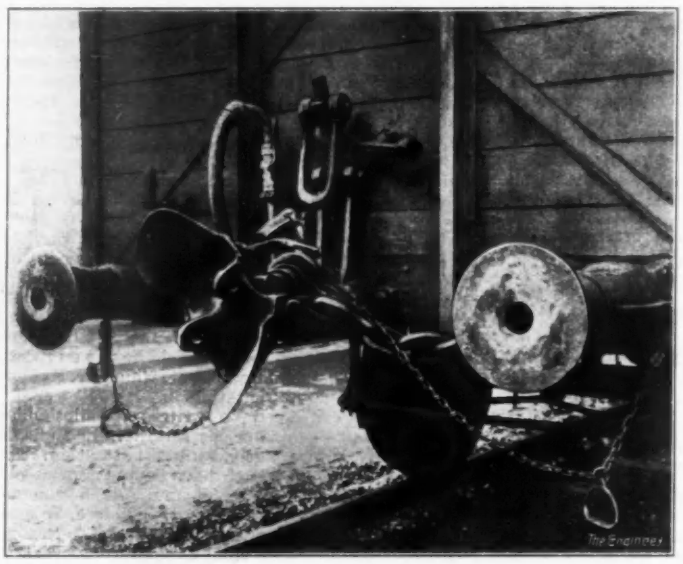
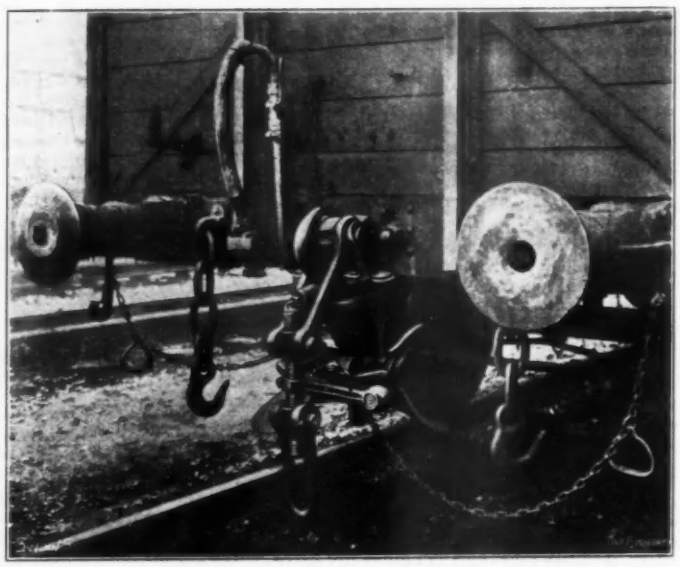


FIG. 5—CENTRAL BUFFER TYPE OF COUPLER





FIGS. 2 AND 3—TRANSITION TYPE OF BOIRAULT COUPLER IN AND OUT OF USE

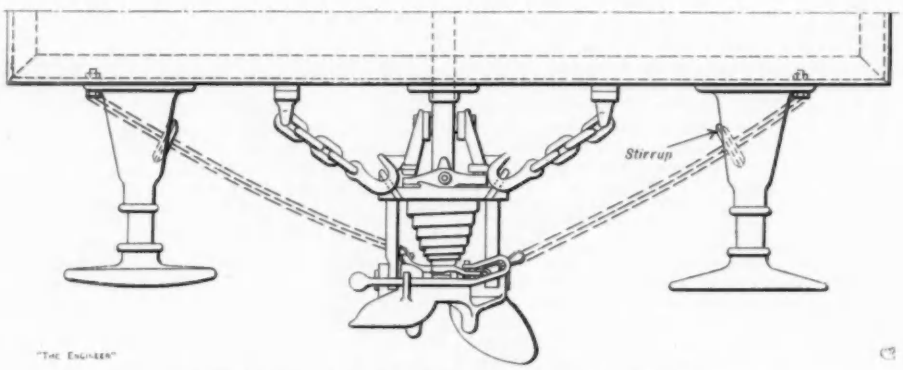


FIG. 4—PLAN VIEW OF TRANSITION TYPE OF COUPLER

FIG. 6—TRAIN PIPE-VALVE GEAR ON COUPLER

Ltd., for sale within the British Empire, in South America, Belgium, Luxembourg, and the Belgian Congo.

The action of the Boirault coupler is much simpler than we are afraid we shall succeed in making it appear, nor is its construction as complicated in reality as our illustrations of it suggest. Certain minor essentials being for the moment neglected and certain parts being treated as plain which are in actuality curved, the coupler as seen by one approaching it appears as a plate A, Fig. 1, from which two lugs B B project and in which two rectangular holes C C are formed. An exactly similar coupler on the end of a second vehicle brought up against the first is indicated by the dotted lines. It will be gathered that the lugs of the second coupler enter the holes of the first and the lugs of the first the holes of the second. A rear view of the first coupler is shown to the right in Fig. 1. In line with each hole C there is a bolt D sliding in two lugs E, and capable of being shot across the hole into a third lug F. Each bolt has a slot on one side which engages with a pin on the face of a lever G mounted on a central pivot. This lever is acted upon by a spiral conical spring H, which tends to turn the lever clockwise, that is, in the direction required to shoot the bolts D into the lugs F. The lever G is held in the position shown, that is, with the bolts withdrawn, by means of a catch J, a shoulder on which engages with the edge of the lug F of the top bolt, the lug being extended upwards and slotted to provide a guide for the catch J. The swelling on the catch which forms the shoulder extends a little below the top edge of the upper hole C. When therefore the lugs of the second coupler enter the holes of the first, the upper lug catches the swelling, lifts the catch J, and allows the lever G to shoot the bolts through holes in the lugs of the second coupler into the lugs F. Simultaneously the upper lug on the face of the first coupler acts similarly upon the locking gear of the second coupler. Consequently when the action is completed, the union is effected by four bolts, each of which is supported by a lug F and the closely adjacent lug E. It will be gathered that the upper lugs B on the faces of the couplers are formed with upstanding narrow ridges K, which form ramps up which travel the swellings on the catches J.

The coupling of the vehicles is effected by pressing them together with a comparatively light force. To uncouple them the levers G are moved anti-clockwise by any convenient means. In Fig. 2 the means provided consists of a chain taken from either end of the lever to either side of the vehicle and furnished with a stirrup. The operator can therefore uncouple the vehicles from either side without passing between their ends. A bell crank lever may be substituted for the stirrup or, as in the case of certain electrified stock on the French State Railways, the control of the lever G may be effected by mechanism which permits the guard to uncouple any coaches not required without his leaving his compartment.

It will be seen from Fig. 2 that in the actual coupler the head carrying the two coupling lugs B and the two holes C is formed with anything but a plane face. Its ears are dished outwards in such a way as to form surfaces that will guide the lugs into the holes should the two couplers not be exactly opposite each other horizontally or vertically. To accommodate any such very probable lack of perfect alignment the head is given a considerable degree of freedom. The spiral conical spring, as shown in Fig. 4, is mounted between the head and a base member to which the head is tied by a pair of pivoting side rods. The base member, side rods and head can assume a variety of angular settings relatively to one another. The base member may be tied, if desired, by the usual safety chains to the buffer beam of the vehicle. It is provided with a pair of rearward extending arms which, as shown in Fig. 3, fit on to the pin passing through the drawhook of the ordinary coupling and taking the links of the ordinary screw gear. As shown in Fig. 3, the automatic coupler has been lowered to allow the ordinary coupling to be used. In Fig. 2 the ordinary coupling is tied back and the Boirault coupler is in its operative position. Some variety exists in the means provided for maintaining the automatic coupler in the horizontal position. In the case illustrated in Figs. 2 and 3—and also in Fig. 4—a simple bridge piece hinged to the base member rests on top of the ordinary draw hook and when in position is locked by a simple action against the base member. In a more elaborate form it is possible to operate this bridge piece or its equivalent from the interior of the vehicle so that the coupler can be dropped by the train staff without passing in front of the vehicle.

The pattern shown in Figs. 2–4 is designed to cover the transition period. The final pattern is the same in principle, but naturally an improved method of uniting the coupler to the buffer beam is provided. The same engravings illustrate the coupler as fitted to a vehicle with double or side buffers. In Fig. 5 we illustrate the coupler as designed for rolling stock of the central buffer type. This pattern is, as shown, fitted with an adjusting device operated by the bogie which brings the coupling head on to the axis of the track and thereby allows coupling to be effected even on sharp curves.

The example shown in Fig. 5 is provided with means for the automatic coupling of the train pipes. The pipes end in orifices in the face of the coupling head, with which similar orifices in the mating coupler engage in a tight manner. From the rear of the coupling head flexible connections are taken to the train pipes. It is obviously required that the act of uncoupling a pair of vehicles should result in the train pipes being closed and the act of coupling in their being opened. The means provided for this purpose can be seen in Fig. 6, which shows the rear face of the coupling head in the coupled position. It will be gathered that a short pipe screwed at one end to receive the flexible connection is attached behind each orifice and that a valve is provided in this pipe. The valves are linked to the lever operating the coupling bolts in such a way that when these bolts are shot home the valves are opened and when they are withdrawn the valves are closed.

It may be objected that if the catch J, Fig. 1, is moved accidentally or otherwise when the coupler is not in use the bolts will be shot into the coupling position and that consequently should another vehicle be shunted against the coupler the bolts will be subjected to the full buffing shock from the lugs of the second coupler. That event would undoubtedly happen. It is claimed, however, that no harm will be done to the bolts by its occurrence. We understand, indeed, that tests have been made with the bolts replaced by wooden pins and that these pins withstood the conditions indicated without fracturing.

On Thursday of last week, at Messrs. Armstrong, Whitworth's invitation, we witnessed a cinematograph demonstration of the application and use of the Boirault coupler. We were particularly impressed with the easy manner in which the coupler could be applied in the first instance to existing rolling stock. No less noteworthy was the obvious facility with which it subsequently could be lowered out of action to permit the ordinary screw coupling to be brought into use and raised again to the horizontal position.

Refrigeration on Shipboard.*

By H. J. WARD, M.A.

REFRIGERATION, which is now definitely established as a necessary adjunct to healthy life ashore and afloat, and as an economic factor of the first importance, may be said to have attained its jubilee in 1929. It is generally agreed that the sailing in 1879 of the steamer "Strathleven," fitted with a Bell-Coleman cold air machine, from Australian ports for London with a small cargo of frozen meat marks the economic beginning of the industry. Rapid development through commercial enterprise has taken place since, until now, half a century later, Parliament has provided an added stimulus by issuing the Food Preservation Regulations. It would seem therefore that a survey of the field on its marine side is particularly justified at this time. The subject may be defined as "the mechanical production of relatively low temperatures for the preservation of perishables during transit by sea." This definition is probably sufficiently wide to cover all existing examples of refrigeration on shipboard.

The subject is far too wide, however, to allow of a full discussion of mechanical details in such a survey, and it is proposed therefore to summarise the various distinctive trades into which refrigerated tonnage has been grouped with some general description of the leading types of vessels which are to-day employed in those trades, of their refrigerating equipment, and of the cooling machinery installed upon some recent examples.

Development during the last fifty years has proceeded steadily and comparatively uneventfully. From time to time the type of machine in most general use has been threatened with rapid obsolescence by some new system or mechanical innovation, but on the whole there have been no startling changes and the commercial interests concerned, directly and indirectly, have not suffered unduly from the pioneer work of engineers. It has been, on the whole, a healthy and sound evolution, in which British names stand out creditably, as might indeed be expected in view of our preponderance as shipowners and our dependence upon overseas supplies of foodstuffs. The most marked change took place about 1890, when the air compression machine yielded supremacy to that using a liquifiable gas as the refrigerating agent; since this important step the improvements have been for the most part matters of detail, so far as the compressor itself and its essentials, the gas condenser and evaporator, are concerned.

Of the various types of modern refrigerating machines, such as carbon dioxide (CO_2), ammonia (NH_3), compression, ammonia absorption, dense air, and water vapour machines, only the two first named have met with any lasting success on board ship. Analysis of the lists published in the latest issue of Lloyd's Register shows that by far the greater proportion of the refrigerating machines installed for cargo purposes operate upon the gas compression system. Of these, 80 per cent. use carbon dioxide as the working medium; 18 per cent. use ammonia; air compression now accounts for only 0·8 per cent.; and other systems for 1·2 per cent. These proportions indicate as between carbon dioxide and ammonia, the special conditions under which marine practice has been developed—on land the relation is quite otherwise—the chief factors being the comparatively harmless character of carbon dioxide and the necessarily stringent regulations of the Board of Trade regarding the installation of ammonia machines in passenger vessels.

The attention given to cargo installations by Lloyd's Register, both in respect of the mechanical construction and the insulation of the chambers, reflects the great importance of the insurance interests to which reference will be made again later.

The reliability in service of the modern marine refrigerating plant has reached a very high standard; it is rarely that any failure to maintain the required temperature occurs, and the claims which reach owners in respect of damaged cargoes involve for the most part questions of handling rather than of temperature. When one considers the immensity and value of the cargoes, which are transported over thousands of miles of ocean and through temperature conditions in the atmosphere and in the sea which often vary greatly within a few hours, the losses sustained by the commercial interests seem indeed small. There is undoubtedly still need for improvement in the technique of handling refrigerated cargoes, and it is none too soon that systematic research has been instituted. All who are interested in refrigeration welcome the research work which is being done by the Food Investigation Board under Sir William Hardy, and by the Low Temperature Station for Research established recently at Cambridge under a scheme of collaboration between the Government and the University.

Engineering students at our universities and technical schools have now in many cases opportunities of handling experimental refrigerating machines, installed and designed for instructional and research purposes. The collective value of these installations in training men to handle intelligently machines which are very susceptible to expert manipulation is considerable, and is apparent in the improved type of young refrigerating engineer one meets with on shipboard. Praise is due, however, to the men of the earlier type who acquired their skill, as many still do to-day, in the hard school of practical experience and without the aid of laboratory instruction. In connection with the educational side of refrigeration, the author would like to pay tribute to the value of the work done by his old teacher, Sir Alfred Ewing, F.R.S., whose treatise "The Mechanical Production of Cold" remains after many years the best text-book on mechanical refrigeration extant.

The research undertaken by leading firms in refrigerating engineering as an establishment charge under the healthy stimulus of competition has been of the greatest value to the industry. Naturally, the results of such improvements as are not patented are not available immediately to their competitors, but the time lag is not usually a long one, and progress has been steady and along sound lines.

The greatest of the various trading interests which depend upon refrigeration on shipboard is that for which it was first developed—the importation of meat to Great Britain from abroad. To convey an impression of the vastness of this trade, a few figures may be quoted from Messrs. Weddel's "Review of the Chilled and Frozen Meat Trade" for 1927. In 1880 the number of frozen carcases (mutton and lamb) imported into the United Kingdom was 400. In 1927 14,985,768 carcases reached these shores, the record number being 16,179,770 in 1921. The world's output of frozen and chilled meat exported in 1927 was 1,256,900 tons.

These cargoes have been carried in vessels of the highest class, generally of good speed and specially designed for the service. The great majority are of British registry and the most highly specialised are those employed in the chilled beef trade between South American ports and the United Kingdom. The design of these vessels entails problems of construction different from those ordinarily met with, as they are subdivided by several insulated decks which must be spaced vertically to give the maximum stowage within the minimum loading dimensions, as measured by the rules agreed upon between the meat shippers and the shipowners. Upon the skill with which the structural features of the ship are disposed relatively to the clear stowage within the insulation, largely depends the earning power of the ship. Most of the insulated capacity is made available for chilled beef in quarters, which are carried by suspension from the deck above or for frozen cargo stowed on the decks or tank tops. The intermediate decks may therefore have to support a double load, and nice problems of strength and stability have to be solved by the naval architect, for whom limitations of draught in the River Plate entail additional considerations of trim. These vessels are necessarily of expensive construction, and every cubic foot of insulated space must be utilised economically. Consequently, the designer of the refrigerating equipment must so dispose his cooling surface in the chambers as to encroach as little as possible upon the useful capacity. The higher up in the cold chamber the cooling surface can be placed, the more effective is the convection. The brine pipes are therefore mostly secured in pairs to the overhead structure, between, and in the same plane with, the galvanised steel tubes which carry the meat hooks and chains. Additional brine pipes are fixed to the walls, and the whole of the cooling surface is arranged upon a number of separate circuits of moderate length, so disposed that the accidental stoppage of one circuit would not seriously affect the distribution of the cooling in any chamber. Chambers may at times be used for produce carried at temperatures above freezing point when drip of condensed moisture from overhead pipes would be objectionable, so provision is made for cutting out those pipes from circulation and using only those on the walls of the chamber. On a large vessel of the latest type there may be as many as thirty-two chambers, in addition to the hatch trunks which form separate spaces between decks; the total insulated capacity may be in the neighbourhood of 600,000 cubic feet, and the number of brine circuits 200; yet the whole brine system, consisting of the repetition of simple units, can be concentrated conveniently for control by the refrigerating engineer on watch.

Frozen meat is usually carried at about 15 deg. Fah., whereas chilled beef requires a temperature of 29½ deg. Fah., say, 1 deg. Fah. above the freezing point of the juices of the muscular tissue. Some shippers require slightly different temperatures for their consignments, and these can be provided in practice with negligible variability by means of the "brine mixing" system. The brine leaves the machine at a temperature suitable for the coldest chamber, but the portion which is delivered to the chambers containing chilled beef is that which has previously returned from the chilled beef circuits moderated in temperature by an injection of the low-temperature brine, and the displaced brine is returned to the evaporator. A very exact temperature balance can be obtained in this way. Where, as is now frequently the case, there are more than two evaporators, with a large mixed cargo of chilled and frozen meat and perhaps some fruit, one or more refrigerating units may be regulated to deliver brine at the chilling temperature while one is on freezing duty, but refinement of adjustment is still performed by low-temperature injection. The brine system generally may be either on the open or closed systems. Both have their advantages and their advocates, and both produce good results.

The high value of the cargoes entrusted to the refrigerating plant necessitates duplication of the units and the provision of ample spare equipment. The surveyors of Lloyd's Register have compiled rules relating to this provision and to the survey of installations while under construction and periodically in service, on behalf of the insurance and other interests involved. One unit must be capable of maintaining the required temperatures at sea when run for not more than 18 hours per day. In practice, owners have generally specified margins in excess of Lloyd's requirements, and the growing size of cargoes has led to the additional precaution of providing complete independence of the units. For cargoes of up to, say, 4000 tons, one duplex machine with twin compressors, driven by a cross-compound steam engine, having a two-throw crank shaft, with two fly-wheels and coupled at the centre, either side being able to run separately, was generally used and found to give ample security. But for larger cargoes a pair of single-line machines each driven by tandem compound engines has often been installed. A number of triple-compressor machines driven by triple-expansion steam engines were installed some years ago by a progressive shipping company in the South American trade. Although these were a step forward they were not more generally adopted, probably because the twin compressors were found to give ample security with reasonable economy. Within the

* The Institution of Mechanical Engineers.

EXAMPLES OF REFRIGERATION PRACTICE ON SHIPBOARD

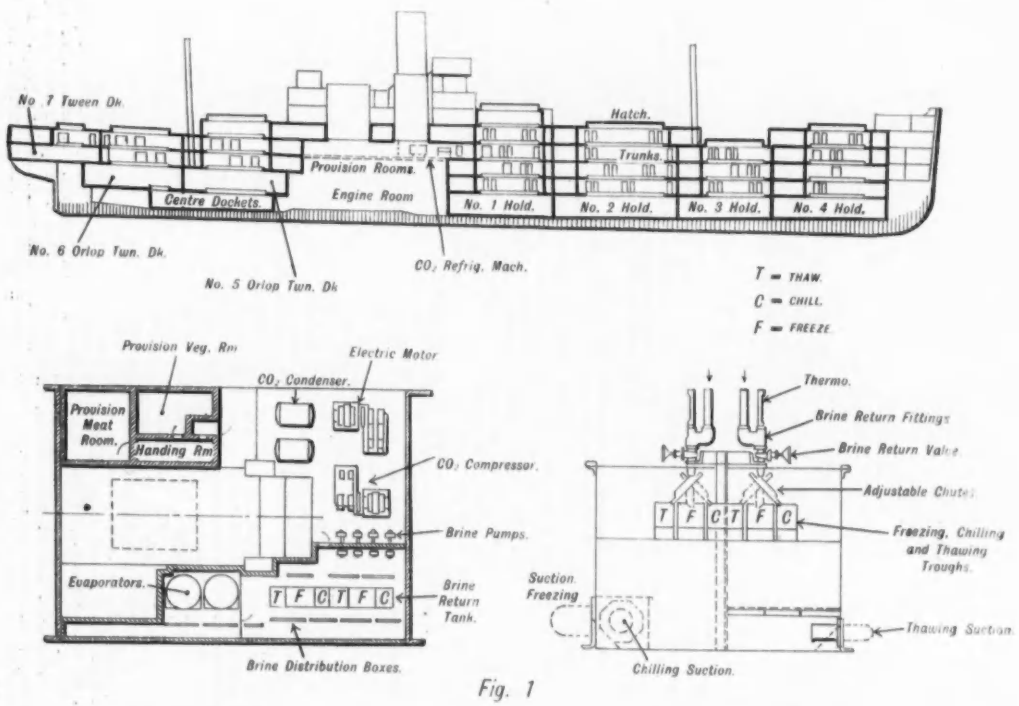


Fig. 1

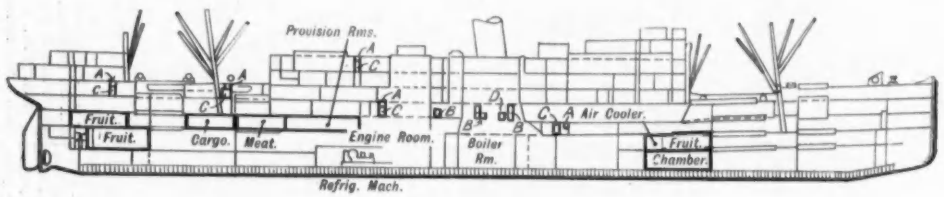


Fig. 4

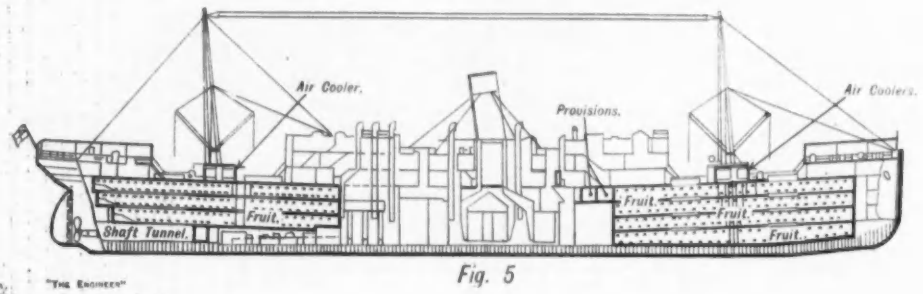


Fig. 5

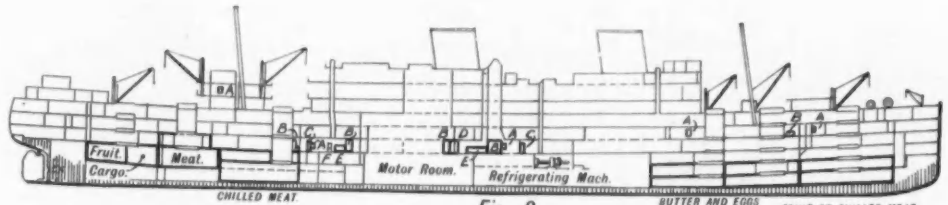


Fig. 2

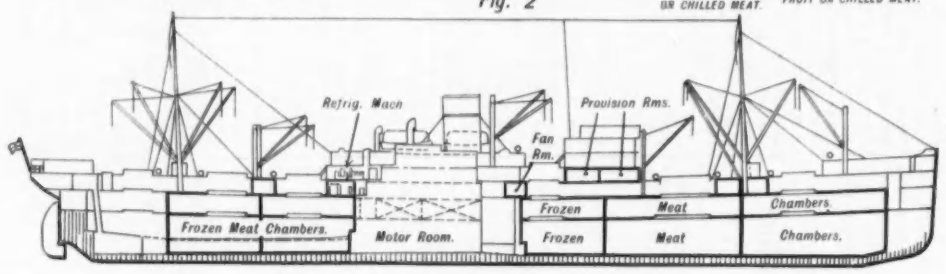


Fig. 3

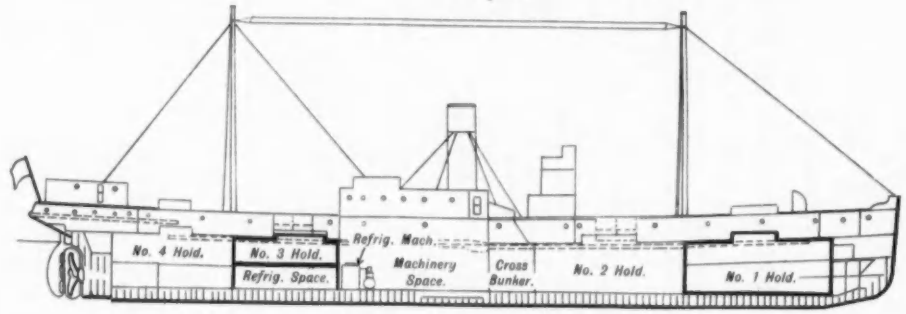


Fig. 6

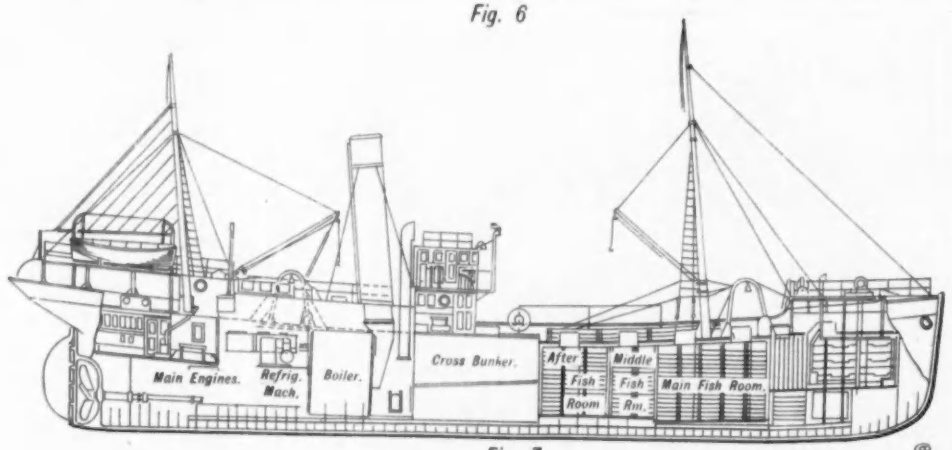


Fig. 7

last few years the use of oil engines for main propulsion and the increasing practice of driving auxiliaries electrically have led to the adoption of higher compressor speeds. The motors drive through gearing or directly through a slightly flexible coupling at speeds up to 150 r.p.m. for compressors with open motion work. As a further step in the direction of economy, compressors may be mounted vertically on totally enclosed frames with the motion parts oiled by forced lubrication; in this case the motor is directly coupled, and may run at a speed of 350 r.p.m. or thereabouts. Such machines effect considerable saving of space and attention, and by eliminating gearing almost noiseless running is obtained, a very important consideration when passengers are carried.

Fig. 1, in which the thick lines indicate insulation, shows in outline the arrangement of a large motor vessel, such as has been described above. This is fairly typical of the modern chilled beef carrier. The arrangement of the electrically driven CO_2 refrigerating machinery is also shown, and some indication is given of the method by which the brine is circulated on the open system at temperatures to meet the requirements of the meat shippers with efficiency and reliability.

A notable departure from usual practice has been made by the owners, who introduced the triple compressor machines mentioned above. In the case of a group of five motor vessels for the South American chilled beef trade, which are now being delivered by their builders, a pair of twin compressor horizontal ammonia machines each directly coupled to a four-cylinder, four-cycle, heavy oil engine is installed, the cylinders being in pairs opposed. This machinery is placed high in the ship and forms a self-contained power unit, capable of being run even if the main engine-room be flooded, as the emergency generators can supply sufficient current for the brine and water pumps to meet the requirements of the refrigerated cargo. Notwithstanding the position in the ship, there has been a noteworthy absence of vibration or noise with this method of drive. Had the compressors been electrically driven, the increased size of the main generators would have entailed a considerable increase of the main engine-room. The brine system is enclosed.

Fig. 2 shows a large oil engine mail and passenger ship in the South American service, having large cargo chambers for chilled meat and other produce. The CO_2 refrigerating machinery is electrically driven and in two units. The letters A, B, C and D indicate various cooling accessories, such as cupboards and water-coolers. An interesting feature of this vessel is the very wide range of speed control of the compressors by means of a "negative booster," from 150 to about 30 r.p.m.

For the Australian and New Zealand trade, a fine type of carrier has been developed. The cargoes consist of frozen beef and mutton, and, at seasonal times, partly of fruit, mainly apples, for which a considerable proportion of the insulated space is specially arranged. The temperature for apples may be as low as 33 deg. Fah. Cheese at 40 deg. to 45 deg. Fah. and butter at 15 deg. Fah. or less are also carried at times as part cargoes. For fruit and cheese, air circulation by electrically driven fans over suitably arranged cooling surfaces, is provided, with arrangements for air changing from time to time.

Fig. 3 shows a recent example of such a vessel, driven by oil engines through twin screws. The CO_2 refrigerating machinery, in two electrically driven units, affords complete facilities for temperature regulation, according to the distribution of a mixed cargo of fruit, dairy produce, and meat, by means of fan circulation on a new system. The mail and passenger steamers in the Australian trade also carry large refrigerated cargoes by the most up-to-date methods. The great length of the voyage between New Zealand and United Kingdom ports is, of course, an important factor in the design of the vessels, but from the refrigerating point of view the number of ports at which cargo is taken in is of greater importance, and it is to be hoped that in course of time improved methods of handling the fruit up to the time of closing the hatches will be evolved, which will include the pre-cooling of the fruit. Rather too much is sometimes expected of the ship's refrigerating plant which should not, strictly speaking, be called upon to do much more than maintain temperatures.

There is a rapidly growing trade in citrous and other fruits from South African ports, which is handled by a fine class of mail and passenger steamers and motor ships. There are also a number of intermediate passenger steamers which have excellent provision for fruit cargoes. Fig. 4 illustrates this type. The CO_2 refrigerating machinery has hitherto been generally steam driven, and air circulation on a new and highly effective system, specially suitable for the more delicate kinds of fruit, such as plums, peaches, and grapes, is being adopted with improved results. The South African Government has taken great interest in aiding the development of the fruit-growing industry in its territory, and has installed large cold stores at the ports for pre-cooling the fruit. This is an example of paternal government which might well be followed elsewhere.

A unique example of a great trade developing from small beginnings in a comparatively short time and in the same hands as a direct result of refrigeration is that of banana importation from the Tropics. It began in 1900 through the enterprise of a Liverpool shipowner who sought to aid a British colony at the call of a great Colonial Secretary. The history of this development is somewhat of a romance, and the author considers it a privilege to have been concerned from the first in the evolution of the fine type of vessel specially built for this trade. Some idea of the importance of the European part of this great business will be afforded by mentioning that the number of bunches of bananas brought to the United Kingdom and continental ports from the Gulf ports in 1927 was 18,109,000, while the maximum number of bunches carried in one vessel was 110,000.

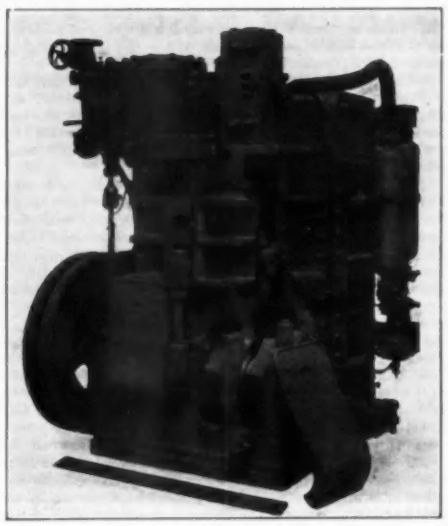


FIG. 16—STEAM-DRIVEN CO_2 COMPRESSOR

Fig. 5 shows the latest type of banana carrier. It is a vessel of the highest class, carrying a number of saloon passengers, and having a good speed. The steam-driven CO_2 refrigerating machinery is accommodated between the tunnel shafting. The fruit, which is stowed unpacked in insulated chambers of the ordinary height between decks, is cooled by the circulation of air across the ship. Close nests of brine pipes are arranged in deck houses over which the air is first passed by powerful fans. A large volume of air is delivered, and provision is made for continuous or intermittent freshening of the air.

A smaller type of trader is that which brings produce from continental ports to the United Kingdom. The example shown in Fig. 6 has two insulated holds, cooled by a single steam-driven CO_2 compressor. The power provided and the cooling surface must be ample, as the cargo received is seldom pre-cooled, and the time during which the cooling has to be performed is comparatively short.

The cooling of provisions for passengers and crew on a modern liner requires an elaborate equipment and considerable power, usually provided by two units. In addition to the separate rooms for meat, poultry, fish, vegetables, milk, &c., in which the required temperatures have to be maintained, there are detached cupboards—for the use of the pastrycook and other important individuals in the hierarchy of gastronomy—ice-making tanks, water coolers, a milk cooler for the "iron cow," and, still more widely spread, bottle coolers in the various bars, the whole forming a brine-circulating system of considerable elaboration. This is to some extent indicated in Figs. 2 and 4. Quite recently the practice of installing small electrically driven compressors has been growing. These work with a low-pressure gas, such as methyl chloride, and cool individual cupboards at points too remote from the main plant to be conveniently connected to it. Cooling is effected by direct expansion and automatic starting and stopping of the plant is controlled by a thermostat.

On many cargo vessels to-day small refrigerating machines, using CO_2 or ammonia, have been installed to take the place of the old ice box. These have been found to effect substantial economy in catering, as purchases of frozen meat can be made at ports where it is cheapest and best.

The fishing industry has been slow to adopt refrigeration, although its advantages would seem obvious. This is partly due to the prejudice against a dry skin, market appearance being of first importance. The long distances which trawlers have now to go to their grounds is leading, however, to a reconsideration of the problem of landing the fish in good condition, and vessels are being fitted with fish holds insulated and cooled by refrigerating plants. The usual practice is to maintain a temperature which will allow of the slow melting of the crushed ice which is sprinkled among the fish, and so preserve the wet appearance, while reducing the ice consumption. A trawler so fitted is shown in Fig. 7.

A development of recent years is slowly gaining ground and may eventually help to solve the problem of the landing of frozen beef from the Antipodes in a market condition comparable with that of Argentine chilled beef. This consists of freezing by immersion in dense brine of common salt—sodium chloride—at very low temperature. Exhaustive research was carried out on this system by Committees of the Food Investigation Board during the war and subsequently, and did much to establish its advantages. The principle involved is that the rapidity of heat abstraction ensures that the crystals forming in the muscular tissues shall be of very fine grain, so as not to cause the rupture and subsequent escape of the juices of the flesh on thawing which results from the coarse crystallisation formed by the much slower freezing by air. Contrary to what might be expected, the penetration of the salt is so slight as to have negligible effect upon palatability.

A number of land installations for fish are working on this system on the Continent, and several fishing vessels have been similarly equipped there. The most important enterprise based on brine freezing, however, is that of a British firm which has fitted out two large steamers for the halibut fishery off the coast of Greenland. The fish are caught on lines from motor dories working from the parent ship on which there is a powerful CO_2 refrigerating plant with brine freezing tanks and glazing rooms. The fish, which are of large size and fine quality, are first frozen in the brine bath and afterwards glazed by immersion in fresh water as soon as possible after being brought on board, and are then stored in the large insulated holds at low temperature. The frost is carefully removed from the fish at the port of discharge, so that the original appearance is restored and they obtain good prices.

All the larger naval vessels are equipped with electrically driven refrigerating plants, usually on the CO_2 compression system and embodying a number of units of moderate size. These are employed for cooling the gun charges, thereby maintaining their ballistic properties and for the preservation of food for the crew. Certain classes of submarines intended for service in hot waters have been fitted with specially designed and very compact CO_2 machines for the main purpose of keeping the storage batteries at temperatures low enough to retain their capacity and to extend their life, which otherwise is short in the Tropics. Advantage is taken of the presence of the plant, as an alternative duty, to cool and dry the air used for ventilation, thereby rendering the conditions more tolerable for the crew. A small cold store is also provided for provisions.

The illustrations given herewith and on page 212 show some photographs of the gas compressors actually fitted on the vessels illustrated in Figs. 1 to 7. Fig. 8 shows one of a pair of horizontal CO_2 machines installed on the large meat carrier illustrated in Fig. 1. Each machine is fitted with a pair of double-acting compressors driven directly through a flexible coupling by an electric motor running at 135 revolutions per minute, with speed control as required to meet all conditions of loading and temperature. When deck space in the machine-room is specially limited, the type of machine shown in Fig. 9 is sometimes adopted as in the case of the large South American passenger ship—Fig. 2. The drive is similar to that of Fig. 8, but the copper condenser coils for the CO_2 are contained in two separate compartments formed in the main base plate. The speed control is of the special type mentioned above. The machines fitted on the Australian cargo boat—Fig. 3—are similar to those illustrated by Fig. 8.

Fig. 10 shows a somewhat similar horizontal machine driven by an electric motor through double helical reduction gear with a ratio of about 5 to 1. Such machines have been used for some large passenger steamers in the

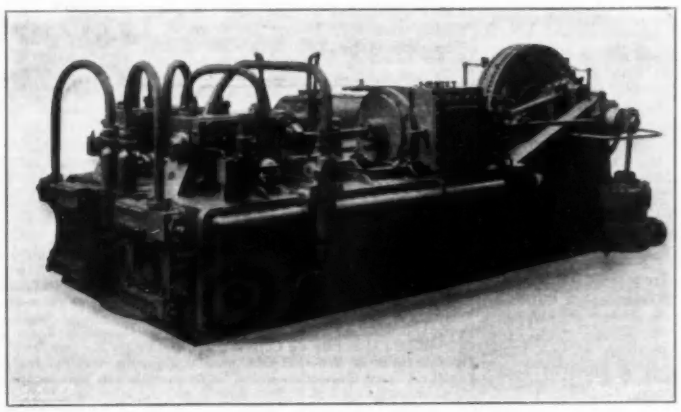


FIG. 14—HORIZONTAL DUPLEX STEAM-DRIVEN CO_2 MACHINE

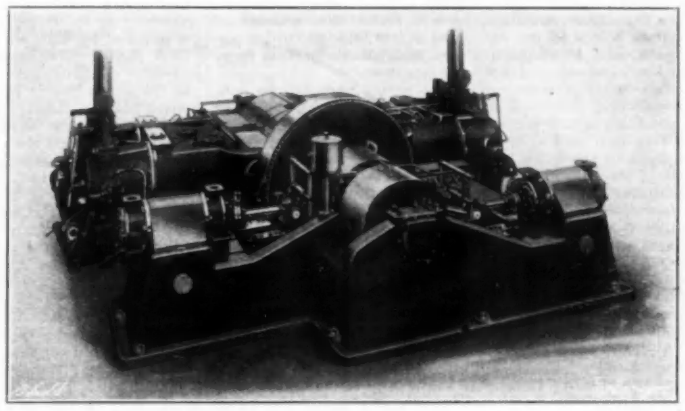


FIG. 15—OIL ENGINE-DRIVEN TWIN AMMONIA MACHINE

Australian trade. Although the intervention of gearing enables the motor to be run at a speed more appropriate to the power transmitted than in cases where the drive is direct, it is impossible to avoid a certain amount of noise from the transmission. With open motion work and gravity lubrication crank shaft speeds above 150 r.p.m. are generally undesirable for large units. To approach the economical speed of the electric motor while avoiding gearing, totally enclosed motion work becomes necessary and full speed can be raised to 350 or 400 r.p.m. The type of machine illustrated in Fig. 11 has been introduced lately as it is specially suitable for vessels where slightly greater headroom can be provided. This machine has a pair of single-acting CO_2 compressors mounted on a totally enclosed frame, with ample doors for access to the glands and motion work, and has forced lubrication to all bearings by means of a pump fitted at the end of the crank shaft. The bearing surfaces are specially liberal, so as to allow the use of refrigerator oil for general lubrication as well as for the compressor glands, thereby avoiding the necessity of carrying two classes of oil.

Fig. 12 shows a similar machine having three compressors. Still larger machines fitted with four compressors are under construction for a large South African passenger motor liner and for a chilled beef carrier of very large capacity for the South American trade. The machines on the South African intermediate liner—Fig. 4—and the banana carrier—Fig. 5—are of the now well-known horizontal duplex steam-driven type, as shown in Fig. 14. The compressors are driven by the tail rods from cross-compound steam cylinders. The crank shaft is in halves coupled at the centre, with two fly-wheels mounted on the couplings. Each half of the machine is capable of being run in emergency as a separate unit under high-pressure steam.

The CO_2 machine fitted on the continental trader—Fig. 6—is that illustrated by Fig 16 and is the largest size of the makers' steam-driven vertical type. The double-acting CO_2 compressors are driven through a two-throw crank shaft by a vertical steam engine and the CO_2 condenser coils are contained in a recess formed in the main frame of the machine. The machine on the trawler—Fig. 7—is a smaller size of the same vertical type shown in Fig. 13. Its evaporator is bolted at the back of the condenser and the brine pump is driven from the crank shaft.

Fig. 15 shows one of the pair of large units, each consisting of twin compressor horizontal ammonia machines, directly coupled to four-cylinder oil engines, fitted on the five new motor ships for the South American chilled beef trade which are now being completed. The first of these vessels has made a round trip and has delivered a cargo of meat in excellent condition, the oil engines and compressors having given complete satisfaction.

There are many variations from the types of marine installations which have been selected to illustrate this survey, and it cannot pretend to be more than a summary, but the author trusts that he has at least said enough to convey to those not directly concerned with refrigeration some idea of the vast interests involved and the great part played in the economics of human life by refrigeration on shipboard.

Railway Constructional Activity in Western Canada.

THE outbreak of war in 1914 closed a remarkable era of railway construction in Western Canada, and the various economic and other difficulties arising since the cessation of hostilities have not enabled the two great transportation systems—the Canadian National and the Canadian Pacific—to undertake correspondingly large programmes of expansion. During the past two or three years, however, both railway organisations have increased their mileage at various points to the extent of a few hundred miles per annum, and developments now under consideration foreshadow extensions of much greater moment.

The opening up of Northern Alberta, Northern Saskatchewan and Northern Manitoba both for mining and for agriculture is now proceeding rapidly, and the importance of this rich and comparatively unsettled area is being brought to the front by the approaching completion this year of the Hudson Bay Railway from the Pas to Churchill, Manitoba, where on the coast of Hudson Bay a port is being erected. This line, it is hoped, will attract steamship traffic from Europe and from Atlantic ports in North America, giving vastly improved transportation facilities for the three provinces of Western Canada, as well as for points in the northern portion of the United States.

CANADIAN PACIFIC RAILWAY PROGRAMME.

A recent issue of the official *Canada Gazette* contains a copy of the application of the Canadian Pacific Railway Company to the Dominion Parliament for authority to construct no less than 1200 miles of new lines in Western Canada at an expenditure estimated at no less than 50,000,000 dollars. Should authority be granted at the session of Parliament which opened on February 7th, the company is expected to embark immediately on this great enterprise, which will provide employment for thousands of men during a period of five years.

The Canadian Pacific programme has for its main object the opening up of transportation to new mineral areas in Northern Saskatchewan, where zinc-copper and gold deposits of immense value are already being exploited in the neighbourhood of the Manitoba border in the territory immediately west of the Hudson Bay Railway line. The programme also contemplates the development of virgin agricultural territory in Saskatchewan and Alberta. A relatively small percentage of the construction programme contemplates lines through country already well settled.

Public interest is most widespread in two long northerly extensions to be built through the mineralised areas in the neighbourhood of the Churchill River, as well as in the long extension across Saskatchewan and Alberta westward from Prince Albert, connecting with the Alberta and Great Waterways Railway near Lac la Biche.

The company already has a charter to build a line in Saskatchewan running westward from Nipawin to Prince Albert, on which work is to be begun very soon. From this line as a base the projected lines spring off to the north and north-west, the first starting from the new bridge being built—at a cost of 2,000,000 dollars—across the Saskatchewan River at Nipawin and reaching Island Falls on the Churchill River, where a great hydro-electric power plant is being constructed to serve the Flin Flon Mines. Winnipeg newspapers publish sketches stated to be constructed from plans prepared by the railway company, showing this line projected even further northward than is indicated by the present application to Parliament, the line continuing across the Churchill River and onward to Reindeer Lake, with a branch to the Sherritt-Gordon mining area on the Manitoba border.

The second of the two lines into the Northern Saskatchewan mineral area is to run almost due north from Prince Albert to Foster Lakes on the north side of the Churchill River. This line would cross the "height of land" between the Hudson Bay and Mackenzie River drainage systems, and would serve the Lac la Ronge and Rottenstone Lake mineral areas, on which a great deal of interest has centred lately as the result of the discovery of copper and nickel deposits of some importance.

Both of the railway branch lines just mentioned are to be built through the great pre-Cambrian shield, which covers most of Eastern Canada surrounding the shore line of Hudson Bay and stretching from the Arctic Ocean in the north to the Great Lakes in the south and to Labrador in the East.

The third and longest of the projected lines, however, is to be built through the Western Canada prairie country, where agricultural settlement is invited, and will stretch from Prince Albert, Saskatchewan, across to Cold Lake on the Alberta border and thence to the Alberta and Great Waterways Railway near Lac la Biche. This line, incidentally, would facilitate the marketing of the immense deposits of bituminous sand near McMurray, at the northern terminus of the A. and G.W. Railway line. The line would be served by two feeders, the longest being an extension from the Asquith-Cloan branch of the Canadian Pacific Railway near Saskatoon to North Battleford, across the proposed Prince Albert-Lac la Biche line, and proceeding northward to Meadow Lake. The other feeder would proceed from Hazeldine, a point near Lloydminster—on the Cutknife-Whitford line—northward to Cold Lake. An important connecting link would be the projected line to run to the Nipawin Bridge from Sutherland, a few miles east of Saskatoon, north-easterly to Melfort, and thence from Gronlid to Pontrilas, which is on the existing line from Tisdale to Nipawin.

Other lines making up the total of twelve branches covered in the application to Parliament are the following:

(1) From Lac du Bonnet, Manitoba, easterly to the Ontario border, going through the Shatford Lake tin-bearing mineral area.

(2) From Bredenbury to Esterhazy, both in Eastern Saskatchewan.

(3) From Crossfield, Alberta, proceeding westerly and northerly.

(4) From Trail, in Southern British Columbia, to Metaline Falls, on the United States frontier.

(5) A new short line in the Sudbury mining area, Ontario.

CANADIAN NATIONAL RAILWAY PROGRAMME.

Sir Henry Thornton, President of the Canadian National Railways, has issued a statement at Montreal intimating that the National system has also in preparation a branch line construction programme which will be brought before the Dominion Parliament during the session, and on which it is hoped to start work early in the summer.

Some of the lines contemplated are believed to be through territory which would be served by the contemplated extensions of the Canadian Pacific Railway system, and the decision of Parliament will therefore be necessary as to which of the lines in question should be constructed by each organisation.

Sir Henry Thornton's statement makes particular reference to the Sutherland-Melfort line announced by the Canadian Pacific Railway, intimating that the Canadian National management has already announced its intention to seek authority to construct a connection between Aberdeen and Melfort in the same territory. The statement further intimates the intention of the National system to construct a line from Ridgedale, Saskatchewan, along the Carrot River to a junction with the Hudson Bay Railway near the Pas, Manitoba, which line, connecting with the proposed Aberdeen-Melfort branch, would afford the most direct route from Saskatchewan and Prince Albert to the Hudson Bay Railway territory. The Canadian National Railways offer no objection in principle to the contemplated Canadian Pacific branch from Nipawin to Lac la Biche, or even to its possible extension to a junction with the Edmonton, Dunvegan, and British Columbia Railway to the Peace River country, though they suggest a different route. The Canadian National management, however, dissents from the contemplated location of a competing line through the territory south of Cold Lake and the Beaver River, which has already been colonised by the Canadian National Railway.

Sir Henry Thornton also suggests the joint use of the Prince Albert-Paddockwood line of the Canadian National Railways in connection with the proposed Canadian Pacific Railway line northward to the Foster Lakes. This suggestion is stated to have been accepted in principle, subject to agreement on other matters.

A Reuter cablegram dated February 11th states that the construction programme of the Canadian National Railways for the next three years includes the building of 695 miles of new branch lines, mainly in Northern Saskatchewan and Alberta, involving an expenditure of upwards of 20,000,000 dollars, for which parliamentary sanction will be asked during the current session. The new lines projected include also extensions to the nickel and copper areas in the Sudbury district of Northern Ontario, as well as a 67-mile branch in Eastern Nova Scotia. The message further states that a conference was held recently between representatives of the Canadian National and the Canadian Pacific Railways with the object of securing an agreement on the respective branch line programmes so as to avoid unnecessary duplication and competition.

FRENCH WEST AFRICAN RAILWAY.

THE exceptionally heavy mortality amongst the native carriers employed on the construction of the railway between Brazzaville and Pointe-Noire, on the Atlantic coast, gave rise to some discussion in France a little while ago. It is only now that an explanation is forthcoming to show that this disastrous state of things was due to an initial mistake in endeavouring to apply European methods to the construction of a railway through a particularly difficult and unhealthy country. Contracts were entered into providing that the line should be constructed within a period of five years. The Government undertook to supply all the native labour required. As time was an essential factor, the builders began to lay the line from both ends. From Brazzaville the work was difficult, involving the construction of numerous tunnels and viaducts, and from Pointe-Noire trouble began when the line approached the almost impassable barrier of the Mayumbe, which had to be reached through dense unhealthy forests and marshes. Another mistake was made when a camp was established in the mountain range to accelerate the work. Obviously, it was impossible to get forward the machinery and plant necessary for carrying out the construction, and the whole of the work had to be done by native labour. The natives were physically unfit and incapable, and they succumbed mainly to the deleterious conditions in the marshes and forests, to a change of living which was unsuited to them, and to unaccustomed work. Notwithstanding warnings from those in charge of the undertaking, the Government of Equatorial Africa continued to recruit native labour until it was made quite clear that the system would have to be abandoned. There was then some talk of importing Asiatic labour, but it is doubtful whether that can offer any solution of a difficult problem. The only way to construct the line safely is to leave time out of the contract, and push forward the railway from the coast with all the plant and material necessary to economise labour as much as possible.

INSTITUTION OF MECHANICAL ENGINEERS.

AT a meeting held in the Lord Mayor's Parlour at the Town Hall, Manchester, on Wednesday last, the preliminary steps in connection with the summer meeting of the Institution were taken by the formation of the Local Reception Committee. In the unavoidable absence of the Lord Mayor, who had already indicated his willingness to act on the Reception Committee and to give a civic reception at the Town Hall during the week of the visit, Mr. H. L. Guy, Chairman of the North-Western Branch, presided. Mr. Guy, in opening the meeting, said that Manchester had given birth to some amongst the greatest of the masters of mechanical arts and sciences, and that Manchester was the home of a tradition of peculiar interest and significance. It was the purpose of the Institution to show that Manchester engineers were to-day doing something to contribute to the engineering traditions of a succeeding generation. He said that the single paper which was to be contributed to the week's proceedings had for its subject "Manchester's Contribution to Mechanical Science Through Research." Nothing could be more gratifying than the way in which suitable visits had already been offered. Already some thirty works of first-class importance had intimated their desire to receive the members of the Institution, and that the spirit shown on all hands placed the outstanding success of the summer meeting beyond doubt. Resolutions were adopted at the meeting to form the Reception Committee and the Executive Committee, on the latter of which the members of the local Branch Committee would act, with power to co-opt other gentlemen. The local Joint Honorary Secretaries appointed by the meeting are Professor Dempster Smith and Mr. Harry Richardson, and the Honorary Treasurer is Sir Christopher Needham.

CONTRACTS.

SIR W. G. ARMSTRONG, WHITWORTH AND CO., Ltd., have received an order from the India Store Department, London, for the construction of forty-six large superheated locomotive boilers and also for a considerable number of locomotive parts for the East Indian Railway Company and the Great Indian and Peninsular Railway Company.

THE WOODALL-DUCKHAM VERTICAL RETORT AND OVEN CONSTRUCTION COMPANY (1920), Ltd., has received the following orders:—(*a*) From the Tokyo Gas Company for an installation of Woodall-Duckham continuous vertical retorts with a gas-making capacity of over eight million cubic feet per day, together with the necessary coal and coke-handling plant; (*b*) from La Compagnie Générale de Construction de Fours for two further installations of Woodall-Duckham continuous vertical retorts at the Clichy Gasworks, Paris. One installation will comprise four batteries each of sixteen retorts and the other four batteries each of twenty retorts, the two installations giving a total daily carbonising capacity of 940 tons.

THE ENGLISH ELECTRIC COMPANY, Ltd., has received from the London and North-Eastern Railway Company an order for a Diesel-electric locomotive equipment comprising a 1000 horse-power high-speed "Beardmore" engine, driving a 675-kW "English Electric" generator and a 10-kW auxiliary generator with control equipment. This material will be mounted on one of the electric locomotives—used on the Shildon to Middlesbrough line—which is already equipped with motors and will now be converted by the English Electric Company for Diesel-electric working. The complete locomotive will weigh 90 tons and will have a draw-bar pull of 40,000 lb. It is proposed to use it for hauling 1000-ton trains at 20 miles per hour.

KEYHAM SHELLBACKS.—The following Engineer-Captains (retired) who entered the Royal Naval Engineering College, Keyham, when it was first opened in 1880, dined together at St. Stephen's Club on Tuesday, February 12th inst.:—W. S. Frowd, C. J. Huddy, J. H. H. Ireland, P. D. Martell, H. W. Metcalfe, G. H. Morris, T. H. Pounds, J. A. Richards, J. M. Simpson, A. T. H. Stone, H. R. Teed. The menu, which showed various shellfish engaged in mechanical crafts, was designed by Engineer-Captain Thompson Gurnell. It is headed "Keyham Shellbacks, 1880," and the names of the courses were selected with careful reference to the occasion.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Market Position.

THE wholesome tone which has prevailed on the Birmingham iron and steel market these past few weeks shows no sign of weakening. The rather larger consumption of material, together with the increasing proportion of native iron and steel being used, encourages hope, and the increasing strength of selling prices keeps interest centred on the business negotiated day by day on the Exchange. Interest this week has to some extent been divided between the Exchange and the British Industries Fair, and iron and steel masters anticipate a large increase in demand for material which will be required to fulfil the orders which manufacturers are hopeful of securing at the Fair.

Steel Values.

Though values of raw material are increasing, the finished steel makers have not yet made any changes in their quotations. The controlled prices of sections, joists and plates, are unaltered, despite the fact that the plate mills are much busier as the result of orders placed by shipbuilders. The call for constructional steel, however, is disappointing. It is reported that some of the Birmingham firms in the constructional engineering trade are having rather a lean time. The inquiries coming in are of almost insignificant dimensions, and in the ordinary way would be turned down by firms used to handling 1000-ton jobs. They are, however, now accepting these small schemes, and there is a good deal of price-cutting to secure even that business. Supplies of finished steel exceed demand, though a diminishing proportion of business is being placed abroad. Particularly does this apply to semi-finished steel, where, on account of the extravagant prices quoted by continental sellers, Midland consumers are using British. While the import returns for January show that a good deal of semi-finished steel came into the country, it is pretty evident that only a small proportion found its way to this district. Birmingham merchants report no relaxation of continental prices. When carriage charges from the port to this district are added, little if any advantage would accrue to manufacturers utilising the foreign material. Billets, for instance, cost about £6, whereas it is still possible to buy English billets and sheet bars at £6 5s. Billets, are not so easy to obtain at that figure as they were, however, and some advance in selling rates, especially for prompt deliveries, would not come as a surprise. Small bars rolled in this country are quoted up to £8. In a few cases £7 15s. is accepted for attractive business.

Pig Iron.

Midland smelters have this week maintained, and perhaps further consolidated, their position, and consumers of pig iron have been forced to buy at makers' prices, except in occasional instances in which supplies have been secured through merchants who themselves had bought before the rise. Smelters, encouraged by their initial success, are speaking of the further advances which they consider necessary to place the industry on its feet. They are being pressed very hard at the moment by the suppliers of coke, who on their part are out for better prices from the blast-furnaces. Any advance conceded ovenmen, blast-furnacemen assert, must be passed on to the consumer of pig iron. Consumers continue to resist the higher rates, and, when they have no need to buy for current requirements, are holding off the market. Where they have no choice but to buy, they have to do so at the seller's figure. Northamptonshire foundry iron was firm at £2 17s. 6d., and consumers in many cases paid the price, recognising that the half-crown will have to be conceded sooner or later. Derbyshire No. 3 foundry changed hands at £3 2s. 6d. Furnacemen claim that the advance has to some extent been followed by more inquiry, and willingness to contract over a period. Quotations for forge qualities are somewhat higher, but sellers are unable to make much progress with negotiations. Most of the consumers have little work on hand, and are not in need of supplies. For the time being they are indifferent to the efforts of furnacemen to raise values in correspondence with the enhanced rates for foundry grades. Output of pig iron in the Midlands is, it is understood, being increased by the starting of two additional furnaces. Whether the improving demand for pig iron will justify such action is problematic, but the furnace owners have evidently satisfied themselves as far as possible on this score.

Staffordshire Iron.

Dearer pig iron has brought up the question of dearer finished iron, but, so far, prices of Staffordshire material have not been revised. The marked bar mills have been running steadily during the past month or two, and a fair number of orders has been booked on the basis of £12 per ton. The Crown bar trade has been brisker of late, but the improvement is not sufficient materially to affect the balance of supply and demand. The increased business has been uneven, and much of it has gone to makers outside this district. Nevertheless, local makers this week attempted to improve selling values and quotations were raised. Producers who were lately accepting £9 10s. are now asking £9 15s., and in special cases £10 is quoted. Crown bars can still be bought, however, at £9 2s. 6d., but they are not of Staffordshire make. Common iron for nut and bolt making is quoted £8 10s. to £8 17s. 6d. The nut and bolt makers are not ordering much in the way of iron or steel on account of the present depression in that industry. Some of this material is, however, finding a market amongst makers of fencing in the Black Country. Wrought iron tube strip sells freely at £10 12s. 6d. There is no apparent diminution in output from the mills, and order books are stated to assure a healthy state of affairs for some little time to come.

Galvanised Sheets.

The galvanised sheet trade, despite the improvement in other branches, remains perhaps the most fortunate section of the industry. Some makers are able to command £13 15s. for 24-gauge corrugated sheets, and the minimum is recognised to be £13 12s. 6d. The mills have sold the bulk of their output to the end of next month, and they continue to book good tonnages, both on home and foreign account. The exports in January totalled no less than 82,524 tons, out of which India took 36,571 tons, Australia 10,254, and South Africa 5818 tons. The December total, it will be recalled, was only 53,573 tons, and in January, 1928, it was 46,513 tons. With progress such as this there is no wonder that makers are maintaining a firm attitude with regard to prices.

Encouraging Auguries.

The expansion in exports of iron and steel and manufactured articles in January gives cause for satisfaction, and Midland manufacturers, taking into consideration the gradual improvement in trading returns recently shown, are of opinion that last month's returns augur well for the future of the industries of this area. They comment upon the fact that in the iron and steel group there was an increase in exports of a million pounds over December, and of rather more over the previous January. The engineering group showed an advance, though the export under the comprehensive head of vehicles was not quite so large as in the preceding month. The prominence of manufactured articles in the expansion of overseas business is reassuring. Shipments of finished goods last month exceeded in value the December shipments by over 7 millions and those of January last year by 5½ millions. Midland manufacturers made a substantial contribution to the total improvement.

Iron Trade Amalgamation.

A big merger of iron trade interests is indicated by the recent move of the Sinclair Iron Company of Ketley, of Wellington, towards rationalisation. The proposed amalgamation of Scotch, North-East Coast, North Staffordshire, and Shropshire light ironfoundries, if successfully accomplished, should undoubtedly place the combined group in a pre-eminent position, and should result in great economies in production, selling and overhead expenses, with a consequent increase in earnings. The firms affected are the Sinclair Company, Abbots Foundry Company, Ltd., R. W. Crosthwaite, Ltd., the James Clay (Wellington), Ltd., Forth (Clyde) Sunnyside Iron Companies, Ltd., Burton Foundry Company, Ltd., Falkirk Iron Company, Ltd., Light Castings Company, Ltd., and Callendar Iron Company, Ltd. Much has been heard lately of the necessity for combination amongst manufacturers, and there seems every prospect that other schemes on the rationalisation principle may follow.

Production Figures.

The advance in the amount of pig iron and steel produced last month and the increase of the number in active furnaces is taken as evidence of a revival of trade in the heavy industries, and iron and steel masters and manufacturers generally in this area express considerable satisfaction with the figures, especially bearing in mind the better trading returns recently published by the Board of Trade. It is eminently pleasing to learn that the number of furnaces in blast at the end of January was 139, a net increase of seven since the beginning of the month, and that although eight furnaces were "blown in," only one ceased operations during the month. The output of pig iron from the blast-furnaces during the month amounted to 563,900 tons, compared with 540,400 tons in December and 560,500 tons in January, 1928. The production included 185,500 tons of hematite, 226,700 tons of basic, 101,600 tons of foundry, and 23,900 tons of forge pig iron. The returns relating to steel also give pleasure. Production of steel ingots and castings in January amounted to 761,600 tons, compared with 683,100 tons in December and 626,200 tons in January. This total is above the average monthly production of the past five years, and better than the 1913 average.

Birmingham Viaduct Scheme.

The great station viaduct scheme, of which the Birmingham City Council has talked for years, and on which I commented in my letter to THE ENGINEER of February 8th, has received a serious setback, which might indeed well result in the abandonment of the whole scheme. By 57 votes to 37 the City Council declined to authorise the Public Works Committee to buy up properties "for the purpose of providing a new road over New-street Station, and connecting Corporation-street and Stephenson-place with Bristol-road, if it may be deemed necessary at some future date." If the Council had accepted its Committee's proposal, it would have taken a very long step indeed towards definite authorisation of the New-street Station bridge. As it has declined to do so now, the Committee responsible for sponsoring the scheme is likely, it is the considered opinion of Midland engineers and others, to abandon it altogether.

Structural Engineers' Dinner.

Major F. C. Cook, chairman of the Birmingham and District Association of the Institution of Civil Engineers, in proposing the toast of "The Institution" at the annual dinner of the Midland Counties Branch of the Institution of Structural Engineers at Birmingham on Friday last, referred to the æsthetic side of the work of structural engineers. Sometimes, he observed, the work of structural engineers was the subject of public criticism, but he was not sure they should accept that criticism as quietly as they frequently did. They could select examples —such as the bridge across the Menai Straits and the Forth Bridge—which did not in any way detract from the beauty of their surroundings. There was a growing sense of responsibility in this matter among structural engineers, who sought to perform their work so that it would not be objectionable to the public taste. It was mentioned during the evening that the membership of the Institution is now 3400, and that of the Midland Branch—the largest of the branches of the Institution—300.

Rolling Stock.

Midland rolling stock establishments continue successful in their search for export orders, and it is gratifying to learn that they are able so effectively to compete with producers in other countries. Their latest successes include orders for Ceylon and the Malay States. An order for 256 four-wheeled covered goods wagons for the Ceylon Government Railways has been secured by the Midland Railway Carriage and Wagon Company, Ltd., Birmingham, and one for thirty-five carriage underframes and bogies for the Federated Malay States Railways by the Birmingham Railway Carriage and Wagon Company, Ltd., Smethwick.

The B.I.F.

The centre of industrial attraction this week has been the British Industries Fair, and it is evident that, large and comprehensive as it now is, still further extension of the space for exhibits will have to be made for the next and forthcoming years. Each year has seen considerable extensions, and it is stated that the erection of another long bay to run right along the side of the existing buildings is contemplated. Mr. G. N. Guest, the chairman of the Fair Management Committee, holds the opinion that in five years' time the Fair will be double its present size. Midland engineering firms were well represented at the Fair, and their exhibits called for much favourable comment. The Fair, and a report of the exhibits, &c., is dealt with elsewhere in this issue.

Unemployment.

A further reduction in the number of unemployed persons in the Midlands is revealed in the latest returns, the total for the week being 175,591, as compared with 184,357, the previous week. Of the total, 126,180 are men, 41,478 women, 3658 boys, and 4275 girls. Bilston and Tipton were the only towns to record increases, the advance in the former being ten and in the latter sixty. The total for the Birmingham area now stands at 26,583.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Good Start in Textile Machinery.

AFTER a falling off in the closing months of 1928, British foreign trade in textile machinery during the opening month of the present year was on a satisfactory scale. Last month's shipments amounted to 11,618 tons, of a total value of £1,055,027, compared with 10,842 tons and £1,079,788 in the corresponding period of 1928, and 8467 tons and £878,670 in January, 1927. The shipments during the period under review included 8397 tons of spinning and twisting machinery, valued at £788,794, and 2605 tons of weaving machinery, of a value of £179,916. There has not been much change in the position from the point of view of individual markets, although it is important to note that Russia shows no indication yet of regaining her former importance as a market for British textile machinery. British India continues to take the lead, the January shipments thence amounting to £259,695; Japan comes next with £82,361; followed by France with £80,847; Germany, £80,830; Russia, £62,666; South American countries, £57,757; the Netherlands, £56,045; China, £50,073; the United States, £39,518; and Australia, £24,129; "other European countries" taking shipments which, in the aggregate, amounted in value to £215,307.

A Chief Gas Engineer?

Although at an adjourned meeting of the Manchester City Council the battles were pretty well fought over again in the long drawn-out controversy which has succeeded the accident at the Bradford-road Gasworks of the Corporation in August, 1927, the final stages are being reached. The Gas Committee was instructed to report to the March meeting of the City Council on the steps it proposed to take in connection with the appointment of a chief engineer, and to determine his duties and those of the general manager. During a long debate in the Council Chamber an interesting statement was made by Alderman Cook, the Chairman of the Gas Committee, concerning the steel materials of which the gasholder was constructed. It had been definitely established, he said, by metallurgists at the Manchester College of Technology, that some of the plating was originally weak. They discovered that it could only have had a tensile strength of 14·35 tons per square inch when it was new, whereas the tensile strength of the plates when the holders were constructed should have been at least 22 tons per square inch. It had also been determined at the College of Technology that some of the plates had no elongation, whereas that factor should have been at least 15 per cent. The report of the examiners stated that the low results on the plates were not attributable to changes in the metal since the holder was erected.

Faulty Steel.

The question of the quality of steel also arose in the course of a coroner's inquiry at Blackpool into the cause of the collapse early in January of a light girder bridge which was under construction whereby three workmen were killed and six others severely injured. A representative of a Bolton firm of constructional engineers which had the work in hand, said that an analysis after the accident showed that the quality of the steel was distinctly poor, and that the material was more like iron. It was not the steel they expected to get, and if they had known its quality they would have condemned it. It was not British steel, although they had paid for it the top price of mild steel of best British quality. Evidence was given by a Manchester consulting engineer, Mr. T. C. O. Chant, to the effect that the accident was caused by one

of the bottom girders breaking. The bridge constructed of normal steel would, he said, have been safe. The steel used was weak and brittle. It was deceptive because it was soft, and dangerous because it was brittle. It was probably foreign steel, and he was surprised that the girders had reached the site without some breakage occurring. Mr. Chant went on to say that constructional engineers paid the same price for British as for foreign steel, but if the steelmaker was buying foreign steel and rolling it he was making an unfair profit against his competitors. The verdict was to the effect that the collapse of the bridge was brought about by the faulty steel from which it had been constructed.

Industrial Results.

Results of three Lancashire engineering concerns issued within the past few days are of interest. Crossley Brothers, Ltd., gas and oil engineers, of Openshaw, Manchester, report a profit for the past year of £56,813, compared with £51,882 in the previous year. No dividend is proposed on the ordinary shares, although, as in the four preceding years, a distribution of 7 per cent. is to be made to the holders of the preference shares. No figures are yet available as to the net profits of Mather and Platt, Ltd., Newton Heath, Manchester, for the year 1928. The directors, however, have just announced the recommendation of a dividend on the ordinary shares of 10 per cent., including the interim dividend of 5 per cent., and a bonus of 5 per cent., both free of income tax, the amount carried forward being £108,006, compared with £131,945 in 1927. The net profits of the Leyland Motor Company, Ltd., Leyland, near Preston, for the year ended September 30th, 1928, increased to £405,998, compared with £233,842 in the previous twelve months, and the directors propose to pay eight years' dividend arrears on the 6 per cent. cumulative preference shares, after wiping out a debit balance of £284,625.

Non-ferrous Metals.

The past week has been a comparatively uneventful one in the market for non-ferrous metals. Interest in the copper section has been rather less pronounced, and there is evidence that some buyers, particularly of refined descriptions, are inclined to adopt a more cautious attitude. Values of standard metal have not lost any further ground compared with a week ago, but neither have they gained anything, and prices current at the moment of writing are, in the case of cash metal, appreciably below the £80 market touched a fortnight ago. There are, however, no signs as yet of any important reaction after the steady advance of the past few months. In tin, also, there has been less buying interest shown during the past week, but in this section quotations have shown further easing and are now virtually back to where they were a month ago, the loss on the week varying from £1 10s. to £3 a ton, according to position. Altogether, the demand for lead has kept up at an improved level, and only a little of the previous week's advance in values has been lost, the market position being regarded as intrinsically sound. There has not been a great deal of interest displayed in the spelter section, and quotations are fractionally easier on the week.

Iron and Steel.

After the relatively exciting conditions of recent weeks the foundry iron market here has become quiet again, so far as fresh business is concerned, orders for only limited parcels having been reported this week. Delivery specifications against contracts are being received from local consumers fairly satisfactorily, and the price position generally retains its renewed firmness, Derbyshire makers quoting 70s. 6d. per ton; Staffordshire, from 72s. 6d. to 75s.; Middlesbrough, about 80s.; Scottish, from 88s. to 90s.; and West Coast hematite from 83s. 6d. to 84s. per ton, all delivered to works in the Manchester area. Prices are steady in the case of manufactured iron at £10 per ton for Lancashire Crown bars, and £9 10s. for second quality material, but the demand in this section is somewhat slow. Except for a continued steady call for small bars, the movement of constructional steel materials, and boiler-plates and general plates is only on a moderate scale and is restructed to early needs. Quotations, however, are very firm at £8 to £8 2s. 6d. for small bars; £7 17s. 6d. for joists; £9 12s. 6d. to £9 17s. 6d. for boiler-plates; and £8 12s. 6d. for tank plates. There has been some inquiry about for continental semi-finished steels, but parcels of these materials are on the scarce side. For foreign finished steel materials the demand is very moderate and is largely a matter of transactions in merchant parcels. Continental mills, however, are in a comparatively favourable position still from the point of view of work in hand, and are well able, therefore, to maintain quotations at a high level in pretty well every department. Slight undercutting in steel bars during the past few days is about the only exception that has come under notice.

BARROW-IN-FURNESS.

Hematite.

As was suggested last week, there has been a stiffening of prices for hematite pig iron ore. The increase in price from the makers' point of view is much overdue. It is difficult to give the exact reason for the low price, a price little in advance of that for East Coast products; but no doubt the fact that stocks had accumulated during the quiet period at various works tended to keep prices down. Now that these stocks are getting down or cleared prices are beginning to rise. It is possible that values may go even higher than at present. At the moment business is steady and inquiries are fairly good. Forward booking has been continued. Better qualities remain in fair demand. The steel departments are taking a fair tonnage of iron at present, and that fact is limiting the amount available for sale. Continental trade continues to be steady if not considerable, but American trade has eased off again. There are slightly better prospects in the iron ore trade both locally and for better sorts outside. Foreign ore is in steady demand, and with the coming spring tides there will be bigger imports during the next week or so. Steel is in moderate demand, and both Barrow and Workington are engaged on railway material at present. Fresh orders are, however, needed. The hoop works are active, and business is steady.

SHEFFIELD.

(From our own Correspondent.)

The Heavy Steel Trades.

THERE is not much improvement yet in the steel trade of Sheffield, although some signs of revival are to be seen in certain directions. There is a somewhat better outlook for acid steel, but the actual demand is poor, as it has been for a considerable time. The one side which does show expansion is that which produces soft basic steels, which are being largely used in place of foreign materials. The recent advance of 5s. in the price of basic billets is justified on the ground that scrap costs more, that material having become scarce owing to the greater consumption at the furnaces, and its cost now being 8s. or 9s. per ton more than it was twelve months ago. There is a good overseas demand for scrap iron and steel, and the exports during January amounted to nearly 50,000 tons. The position in North Lincolnshire continues strong. The Redbourne Hill works there are being restarted after a stoppage of nearly four years, and it is estimated that before this year is far advanced they will be turning out about 5000 tons of steel per week.

Basic *v.* Acid.

The figures of steel production for December last are now available, and they emphasise the extent to which basic steel is gaining ground, while acid steel is losing it, not only in Sheffield but in all districts of the country. There has, in fact, been a continuous decline in acid during the past twelve months or more. The output in the Sheffield district during November amounted to 76,900 tons, as compared with 102,700 tons in November, and 76,400 tons in December of 1927. Of the total, only 27,000 tons were of acid quality, while basic production reached 42,000 tons. The Lincolnshire figure for basic steel for December was 46,900 tons, an increase of 10,000 tons as compared with the previous December. That district also produced 63,500 tons of pig iron—mostly basic—which showed an increase on the year of 9000 tons.

The Manufacturing Side.

There is no considerable change to report in the position of the rolling mills, all of which are wanting work. Valuable contracts continue to be received for heavy manufactured steel, but, generally speaking, orders are on the small side, and there is a lack of continuity, as consumers are not yet buying forward. A rather better demand from the shipyards is reported. With regard to railway supplies, there is no improvement, as the British companies are still pursuing their policy of buying only sufficient for immediate requirements, and the construction of new rolling stock in the country is at a very low ebb. Sheffield is interested in some recent contracts given out by the Crown Agents for the Colonies, as the Midland Railway Carriage and Wagon Company, Ltd., of Birmingham—which is one of the concerns in the recently formed Vickers-Cammell group—is to make 256 four-wheeled covered goods wagons for the Ceylon Government Railways. The demand from the colliery industry continues poor, but it should improve if the present condition of trade continues. Owing to the severe weather in this country and on the Continent, there is a greatly increased demand for house coal, and some other classes of fuel, which is benefiting both the inland and export departments, and complaints are heard of a shortage of wagons.

Colliery Developments.

The Shireoaks Colliery Company reports that the development of the new colliery has been interfered with during the past year by dislocations in the seam, but good progress is now being made. It has been decided to install electric power plants at Shireoaks and Whitwell, and to link up the whole of the remaining pits by an overhead power transmission line. This will effect a considerable saving in costs. Good progress has been made with the work, which is expected to be completed in June next. Steetley Colliery has been completely electrified with the exception of the winding engines; and Shireoaks Colliery is running on electricity to the extent of the power at present available for the new colliery.

Cutlery and Plate.

While a few of the cutlery and plate factories are well employed, especially those catering for hotels and restaurants, general conditions are unsatisfactory. The amount of new business booked this month has been disappointing, and in the majority of cases makers report that the state of things is worse than that of twelve months ago. The ordinary demand, through the retail shops, is very poor. There is a large output of stainless knives—so much so that it was stated at a recent trade meeting that the machine-grinding plants of the city are dealing with 2000 gross of blades per week. There is, however, not much employment for hand grinders. There is a moderate demand for spoons and forks. Efforts are being made to produce an alloy for spoons, forks and hollow-ware that will resist tarnish and domestic stain. Experiments are being carried out by one firm with a copper-nickel alloy with which considerable progress has been made lately. There is a confident anticipation that sooner or later a metal will be placed on the market which will answer the purpose, and will at the same time be produced easily and at a minimum cost. Not only Sheffield and Birmingham, but also firms in Germany and America are trying to evolve an alloy of this character.

Selby Launches.

A good state of activity is maintained at the Ouse Shipbuilding Yard of Cochrane and Sons, Ltd., Selby. Last week the firm launched two more fishing vessels, which were among the largest ever built at the yard. They were steel screw craft for Grimsby owners, and each measured 140ft. B.P. by 24ft. by 14ft. moulded.

A Great Greek Contract.

There have been several references in the Press during the past week to the great contract for reclamation and irrigation in Greece, which has been awarded to Henry Boot and Sons, Ltd., of Sheffield. I have previously referred to this work, which is to render a vast area of land suitable for agriculture, and the estimated cost of which is something like £10,000,000. The position now is that the contract has been agreed to between the firm and the Minister of Communications in Greece. It is awaiting the formal approval of the Greek Cabinet. Mr. Charles Boot, the head of the firm, who has spent several months in Greece in connection with the negotiations, states that the question of that approval is only formal. The contract will afterwards have to be ratified by the Greek Parliament. It is expected that the survey of the work will begin during the next few months, and that operations will actually be started a year hence, and will probably go on until 1940. The orders for the whole of the plant and contractors' machinery will be placed within the first two years of operations, and it is quite likely that they will provide a good deal of work for Sheffield firms.

New Rotherham Bridge.

The construction of the new Chantry Bridge over the river Don at Rotherham, which will greatly improve facilities for communication between Rotherham and Masborough, is making good progress. One abutment, which has now been completed, contains 2740 yards of mass concrete. The excavation amounts to 1040 cubic yards in the river bed, and about 6000 lineal feet of interlocking steel piles were driven to form a cofferdam for the work. The concrete in this abutment reaches a maximum depth of 23ft. 9in., the foundation being about 12ft. below the normal river level. The span is about 97ft., and the width 60ft. The arch will be constructed entirely of reinforced concrete. The engineer for the bridge is Mr. Vincent Turner, M. Inst. C.E., borough engineer of Rotherham, and the work is being carried out by the Yorkshire Hennebique Contracting Company, of Leeds.

New Electricity Plant.

The Mexborough Urban District Council has installed new plant at its power station for the purpose of converting a bulk supply of electricity received from the Yorkshire Power Company into direct current for distribution. The plant, which consists of two 1000-kilowatt motor converters, has cost £12,000, and was formally set to work last week. The whole of the electricity for the town's requirements can now be received and converted at the power station without current being generated.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

THE Cleveland pig iron trade appears to have definitely entered upon more prosperous times. The market is now in a very firm position, and supplies of iron are so scarce that a further advance in prices would create no great surprise. Whether it would be wholly in the interests of the industry is another matter. Ironmasters have to weigh ultimate effects carefully before they resort to an increase in quotations, and there is urgent need for business expansion in order to find employment for idle plant. On the other hand, there is no profit at present in pig iron production, and, realising that delays may be dangerous, buyers are in some instances offering to negotiate for supplies up to the end of the year. Midland iron is still a competitor with Cleveland, but the output is limited, and any increase in demand would at once benefit this district. Already, buyers seem prepared to operate with greater freedom, but the makers in this area have very little iron to sell, and it is not easy to place an order for immediate execution. The severe weather is retarding shipments, but there has been some improvement in the volume of trade from overseas. Prices are firmly held, No. 1 Cleveland foundry iron being 69s. 6d.; No. 3 G.M.B., 67s.; No. 4 foundry, 66s.; and No. 4 forge, 65s. 6d.

Hematite Pig Iron.

Producers of East Coast hematite pig iron are in a very strong position, and a further rise in quotations would cause no surprise, particularly as ruling rates are low compared with figures named for Cleveland pig iron. Though higher terms are asked and are stated to have been realised, consumers claim that they can still place orders at the equivalent of 72s. for ordinary qualities of hematite, which is only 5s. above the price of No. 3 Cleveland, whereas in pre-war times the difference in values was 8s. to 10s. There are now virtually no stocks of hematite, and the restricted make is promptly taken up as it becomes deliverable. Conditions are now such as to warrant producers re-kindling idle furnaces.

Ironmaking Materials.

There is no change in the foreign ore trade. Business rules on very quiet lines, but merchants maintain a firm attitude. Best Rubio ore is quoted at 22s. 6d. c.i.f. Tees. Blast-furnace coke is in improved demand, and prices are inclined to harden. Good average qualities are quite 18s. delivered to works on the North-East Coast.

Manufactured Iron and Steel.

Encouraging accounts continue to be given of the manufactured iron and steel trade. Rather heavy sales of semi-finished steel have been put through, and values of some materials tend upward. More substantial transactions in finished steel are reported, improvement in export demand being somewhat marked. The usual spring buying of sheets has placed producers in a very satisfactory position, as they had already a considerable amount of work to execute. Producers of railway material are fairly busy, and manufacturers of shipbuilding requisites have a good deal of work in hand. Quotations for all

descriptions of finished iron and steel are firmly maintained.

Works Extension.

A. Reyrolle and Co., Ltd., switchgear manufacturers, who already have two large works at Hebburn-on-Tyne, are to proceed with a scheme for extending the New Town Works on a site of approximately 20 acres. Although the output of switchgear from the two factories is very large, it has been found necessary to make the extensions, which will consist of two bays, each 249ft. in length, 40ft. in width, and 32ft. in height. These two additional shops will be equipped with a number of electrical welding sets and several large electrically-driven metal-cutting and bending machines. In order that heavy material, such as large castings, massive steel tanks and the like can be rapidly and effectively dealt with, each shop will have a 5-ton electric travelling crane. The electric power supply will be obtained from the existing sub-station on the premises, which at present controls the supply to the whole of the New Town Works. The firm recently obtained an important contract in connection with the extensive electrification scheme in the south-east area of the country.

Shipbuilding Prospects.

The wintry weather conditions have seriously interrupted operations at North-East Coast shipyards. At some of the establishments outside work was suspended all last week. A satisfactory feature of the shipbuilding situation is that the demand for new ships, though not so great as two or three months ago, is continuing. Although confirmation is lacking at the time of writing, it is understood that North-East Coast shipbuilders have recently booked further orders. It is expected that the Admiralty orders for new destroyers and submarines, &c., will be shortly announced. The Palmer Shipbuilding and Iron Company, Ltd., Hawthorn, Leslie and Co., Ltd., and Swan, Hunter and Wigham Richardson, Ltd., are expected to get the orders for two destroyers each, while Sir W. G. Armstrong, Whitworth and Co., Ltd., are being mentioned as likely builders of two sloops.

The Coal Trade.

The Northern coal trade position shows little change so far as actual demand is concerned. Buyers are numerous, and press for both prompt and March shipment supplies, but fitters are heavily booked, and in ordinary circumstances are practically sold out. Recently buyers have been able to secure catch cargoes, but with milder weather there is every prospect of stemmed tonnage now coming forward in excessive volume, and thus any new business is difficult to place. Shipments at all centres are more active, and coals are getting down to the berths more freely, so that the recent causes of delay have disappeared. Exports to Northern Europe are largely held up because most of the ports are ice choked, but for the southern home districts there is a heavy demand, as the consumption for domestic purposes has been stimulated by the hard weather. The large volume of home business which has come to Northumberland and Durham in recent months may, however, show a decline to some extent in the near future, as the collieries in the Five Counties Scheme—Yorkshire and the Midlands—are to work to full capacity during the next few weeks. Hitherto, they have been restricted to a quota plan. A larger Yorkshire output may mean increased shipments from the Humber and also more rail business for the South of England, and perhaps less for Northumberland and Durham. For Northumberland steams the tone is very firm, and the outlook for some weeks ahead quite cheery for the owners. Buyers continue to offer maximum recent quoted values for any position to the beginning of April. Best steams are at a minimum of 16s., and secondary qualities command 15s. Steam smalls are in brisk demand, and easily cleared at 10s. The gas coal trade is brisk. Best Durham qualities are firm at 15s. to 15s. 3d.; secondary gas steady at 14s. to 14s. 6d.; and special gas qualities, 15s. 3d. to 15s. 6d. There is a heavy home and export demand for coke. Makers are well booked, and offer sparingly for next month. Prices are steadily hardening, 19s. to 20s. now being firmly quoted for gas coke. Patent oven cokes are firm, but as production is heavily booked to the end of March, few transactions are recorded, and prices hold steadily at 20s. to 21s. Beehive and special cokes are 24s. to 28s. 6d.

SCOTLAND.

(From our own Correspondent.)

Cheaper Steel.

IMPORTANT developments in the manufacture of steel in Scotland are embodied in a scheme to exploit the most modern ideas in American and European practice. Representatives of a syndicate which has been formed to promote the enterprise are negotiating with the Coltness Iron Company, with a view to linking up that company's blast-furnaces at Newmains with the scheme. The present arrangements include the erection of a coke oven plant and 2000-ton blast-furnaces operated on the new hot-metal process. It is computed that Scottish steel users will be able to purchase steel ingots £1 per ton cheaper than they can be imported, and in this connection it is stated that one large combine has already contracted for 4000 tons per week. The gas manufactured will be used, in the first instance, for the firing of the coke ovens, but there will be a large surplus available for sale, and it is being offered to the gas departments of Glasgow Corporation and the county of Lanarkshire. In the first instance, the syndicate proposes to provide the Glasgow Corporation with a supply of 3,000,000 cubic feet per day, and to work up gradually to 10,000,000 cubic feet, and the cost would be lower than that at which the Corporation can manufacture. In the case of Glasgow, gas pipes would be laid from Newmains to the nearest suitable point at the city boundary, and delivered thence into the city mains. It is understood that a provisional arrangement has been completed for the supply of 10,000,000 cubic feet per day. In mid-winter the Glasgow Corporation uses a maximum of about 43,000,000 cubic feet per day, and in mid-summer a minimum of about 20,000,000 cubic feet per day. It is intended to link up the Newmains blast-furnaces with the scheme. These furnaces have been idle since the end of 1924.

Oil Workers' Wages.

The Scottish shale miners and oil workers have decided to ask their executive to approach Scottish Oils, Ltd., for an advance of 10 per cent. in wages. Wages were reduced by 10 per cent. last year.

Steel.

The steel works are comparatively well employed, business on the whole being better than it was a few months ago. Heavy steel materials are in good demand for home consumption, and there is a fairly strong export demand for plates and sections. Prices are still unchanged, but the higher costs of raw materials may compel an early adjustment. Steel sheets are comparatively quiet, owing to the fact that many consumers purchased supplies in the autumn sufficient to cover their requirements until the end of February.

Iron.

Those bar iron works which suspended operations two weeks ago are still idle, negotiations having broken down meantime. Consequently, those works remaining open are busier than they have been for some time back. Re-rolled steel is also affected by the dispute, and being in steady demand is very firm at £7 15s. per ton, home or export. Pig iron is a shade busier since the iron moulders resumed work, but the total production is still very restricted.

Scrap.

The demand for scrap is only moderate, but supplies are not over-generous, and prices are firm as follows:—Heavy steel 70s. and heavy basic 67s. 6d. per ton.

Coal.

Owing to weather conditions at home and abroad, and also in a slight measure to the partial failure of collieries in Poland to meet commitments, the coal market continues to show considerable strength. All classes of fuel are scarce, and any small quantities becoming available for shipment are changing hands at extremely firm prices. Aggregate shipments amounted to 151,682 tons, against 255,385 tons in the preceding week, and 231,432 tons in the same week last year.

Colliery Stoppage Averted.

The threatened stoppage of Scottish winding enginemen, owing to a proposed reduction of wages, has been avoided. The coalowners intimated a reduction of 8d. per shift, which was resisted by the men. A representative of the Ministry of Mines Department met representatives of both sides, and secured their presence at a conference last week-end, and, it is said, largely as a result of these efforts at conciliation, an agreement was arrived at. The terms of it are as follows:—That the special allowance of 1s. 8d. per shift be reduced by 6d. per shift, and that the remainder—1s. 2d. per shift—be merged into the basis rates, on which in future any percentage advance or reduction of wages will be made.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

DURING the past week or so the conditions in the coal trade and at the docks have been in a very unfortunate state on account of the severe weather which has prevailed. The heavy frost and fall of snow which have been experienced almost brought the industry to a standstill. At the ports under the control of the Great Western Railway Company, shipments last week came to only 281,376 tons, as against 579,738 tons in the previous week. As the result of the bad weather quite a number of appliances were rendered temporarily useless, and at some of the docks work on the shipment of coal was brought entirely to a standstill. The position was undoubtedly extremely serious, and the outlook very disturbing, as quite apart from the inactivity in the shipment of coals and all that that meant in the loss of money to the Great Western Railway Company, coalowners and coal exporters and shipowners and wages to the workmen, there was the disappointment that further business could not be entertained on account of the fact that delivery of the coals could not be undertaken. The cold spell has meant a better inquiry from abroad for prompt supplies of coal, but coalowners with very few exceptions are not in a position to take on further business for the reason that they are already in arrears and have tonnage in dock or due which will keep them busy for several weeks. At the end of last week there were fifty-five vessels waiting in South Wales ports to load, and on Monday the returns showed that this figure had been increased to eighty-nine. Such a situation has not been experienced in this district for several years past. Unfortunately, it is to be feared that the conditions will be some time before they become normal, though one fact is outstanding, and that is that collieries should have a fairly active time from now right up to Easter. There is still a moderately good demand for coals, and the Paris-Orleans Railway is reported to have purchased a fair quantity of coals for early delivery. Tenders also were sent in this week for 120,000 tons of small coals for the Portuguese State Railways for delivery over the next few months.

Speeding Up Work.

Some idea of the difficulties experienced of late in shipping coals is given by the fact that the workmen have had to dig the coals out of the wagons. Picks and shovels have been resorted to in order to get the coals out, and that has not only had to be done to washed duff and such qualities, but even large coals have been frozen in the wagons. In such circumstances it is not surprising to find that the rate of shipment reached has been extremely low and has amounted in some instances to only a few wagons per hour. At some collieries work was interfered with for the reason that many men could not get to the pits on account of the snow, but at the majority of collieries operations were gradually reduced almost to a standstill owing to the shortage of empty wagons. It is only natural that some steps should be taken by all parties to meet an unusual situation. In the first place efforts were made to get the trimmers and tippers at Cardiff, Penarth and Barry, where the call for urgent measures was strongest, to work over last week-end, but the employing interests and the men's representatives failed to come to an agreement. The men would not have Sunday work and for extra work on Saturday they asked for the payment of 2s. 6d. per hour per man. The employers felt that the terms were wholly unacceptable. The Great Western Railway Company, fully alive to the danger of appliances being left idle over the week-end, arranged for a special staff to come down from its Swindon works to attend to any repairs that were required, and steps were taken to keep appliances moving so as to prevent a recurrence of freezing. On Monday there was a special meeting of the Chamber of Commerce at Cardiff, and negotiations followed with the men's leaders regarding extra work so as to deal with the accumulation of tonnage. As the result of meetings of the workmen during the week, and the men's leaders were in a position to negotiate further, and the outcome was that agreement was come to which enables loading operations to be continued between the termination of the day shift and the commencement of the night shift, that is from four p.m. till 8.30 p.m., by those men who might be regarded as surplus owing to appliances being out of commission. This arrangement was to operate forthwith, and it meant that so far as Cardiff, Penarth and Barry are concerned, there were to be three shifts from 7 a.m. to 5.30 a.m. the next day, with a suspension of work between 5.30 a.m. to 7 a.m., the three shifts being:—7 a.m. to 3 p.m., 3 p.m. to 10 p.m., and 10 p.m. to 5.30 a.m. At the moment of writing it is impossible to say how this arrangement is working out, but it should be borne in mind that the extra work to be carried out only applies so far as surplus workmen are available, and in the case of Barry Docks it is already stated that as there are no surplus workmen no extra work is being done. It is understood that this emergency measure only operates for a week, when the position is to be reviewed.

Steel and Tin-plate Items.

Very little progress was made at a special meeting of the Joint Standing Committee of the South Wales tin-plate trade last week, when the proposed revision of the men's sliding scale came up for consideration. The proceedings were adjourned to a date to be fixed later. Addressing the Swansea Rotary Club on Monday, Mr. Lewis Jones, the secretary to the South Wales Siemens Steel Association, said that he was glad to report that for the first five weeks of this year the South Wales steelworks produced, on an average, a bigger output than they had produced for five years, the total being 155,000 tons. Dealing with the question of high prices, railway freights, &c., he said the fact that their sale price was between only 6 and 7 per cent. above the pre-war figure was a feather in the cap of Welsh steel manufacturers, particularly at the present time when so much was being said about South Wales and old-fashioned methods.

Tin-plate Works.

At the old Castle Tin-plate Works, Llanelly, only six out of the seventeen mills have been operating for some time past owing to the depression in trade, while during the past fortnight the whole works has been idle under the pooling scheme. On Monday next, however, it is understood that ten mills will make a restart.

Current Business.

Owing to the abnormal conditions which have prevailed both in the coalfield and at the docks during the past week or so new business has been slow to mature. Collieries have declined for the most part to enter into any additional commitments for anything like early shipment owing to the heavy amount of tonnage they have to load and the arrears they have to make up. For any parcels that they may have to spare they are able to get top current prices that are quoted. Their position for the next few weeks is fairly secure so far as orders are concerned, but the danger is that tonnage for later loading may be scarce, as owners are reluctant to send their unfixed steamers to this district owing to the congestion which prevails. Quotations for coals are for the most part nominal, and pitwood displays no change from about 26s. to 26s. 6d.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. W. VINCENT WAITE, formerly chief engineer and general works manager of Robert Heath and the Low Moor Iron Company, Ltd., has been appointed general manager of Sensible Heat Distillation, Ltd. ("L and N" process).

WE are asked to announce that control of the engineering and construction firm of J. G. White and Co., Ltd., of 9, Cloak-lane, London, E.C. 4, has passed to J. G. White and Co., Inc., of New York, through acquisition of more than 95 per cent. of the share capital.

JAMES HENDRY, Ltd., the head office of which is at 252, Main-street, Bridgeton, Glasgow, asks us to announce that it has appointed Mr. T. S. Riley, Wh. Ex., A.M.I. Mech. E., as its London representative—vice the late Mr. Wynbloom, M.I. Mech. E.—with offices at 16, Union-court, Old Broad-street, E.C. 2.

STOTHERT AND PITT, Ltd., of Bath, ask us to announce that they have appointed Messrs. G. H. Draper and Co., of St. Jude's Chambers, 28A, Smallbrook-street, Birmingham—telephone, Midland 4836—as their Midlands agents for their mixer department, which specialises in concrete mixers, roadmaking and quarry plant.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	17/6 to 19/–
(1) Spanish	21/–
(1) N. African	21/–
N.E. Coast—	
Native	18/– to 21/–
Foreign (c.i.f.)	22/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 15 0	—
No. 1 Foundry	3 13 6	—
No. 3 Foundry	3 11 0	—
N.E. Coast—		
Hematite Mixed Nos.	3 12 0	3 12 0
No. 1	3 12 6	3 12 6
Cleveland—		
No. 1	3 9 6	3 9 6
Silicious Iron	3 9 6	3 9 6
No. 3 G.M.B.	3 7 0	3 7 0
No. 4 Foundry	3 6 0	3 6 0
No. 4 Forge	3 5 6	3 5 6
Mottled	3 5 0	3 5 0
White	3 5 0	3 5 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
,, ,, Foundry	3 5 0	—
(3) Northampton—		
Foundry No. 3	2 17 6	—
Forge	2 13 0	—
(3) Derbyshire—		
No. 3 Foundry	3 2 6	—
Forge	2 17 6 to 2 18 6	—
(3) Lincolnshire—		
No. 3 Foundry	3 1 0	—
No. 4 Forge	2 17 6	—
Basic	3 2 6	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 1 6 (*a*); 4 5 0 (*b*); 4 8 0 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 10 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
Double Best Bars	11 5 0	—
Treble Best Bars	11 15 0	—
Lancs.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	13 0 0	—
S. Yorks.—		
Crown Bars	10 10 0	—
Best Bars	11 0 0	—
Hoops	12 10 0	—
Midlands—		
Crown Bars	9 2 6 to 10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 10 0 to 8 17 6	—
Gas Tube Strip	10 12 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ¼in. and up	8 7 6	7 12 6
Sections	7 17 6	7 2 6
Steel Sheets, ¼in.	8 15 0	8 12 6
Sheets (Gal. Cor. 24 B.G.)	13 10 0	13 12 6 to 13 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 15 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	7 15 0	—
Soft Billets	6 15 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 0 0	—
Light Rails	8 5 0 to 8 10 0	—
Billets	6 15 0 to 9 10 0	—
Manchester—		
Bars (Round)	8 17 6	—
,, (Small Round)	8 0 0 to 8 2 6	—
Hoops (Baling)	10 0 0	9 15 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 12 6 to 8 17 6	—
,, (Lancs. Boiler)	9 12 6 to 9 17 6	—
Sheffield—		
Siemens Acid Billets	8 15 0 to 9 0 0	—
Hard Basic	8 15 0	—
Intermediate Basic	7 5 0 to 7 15 0	—
Soft Basic	7 0 0	—
Hoops	9 5 0 to 9 10 0	—
Soft Wire Rods	7 15 0 to 7 17 6	—
Midlands—		
Small Rolled Bars	7 15 0 to 8 0 0	—
Billets and Sheet Bars	6 5 0 to 6 6 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 12 6 to 13 15 0	—
Angles	7 17 6	—
Joists	7 17 6	—
Tees	8 17 6	—
Bridge and Tank Plates	8 12 6	—
Boiler Plates	9 15 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	18/– to 18/3
Block Tin (cash)	223 0 0
,, ,, (three months)	223 15 0
Copper (cash)	76 10 0
,, (three months)	77 3 9
Spanish Lead (cash)	23 3 9
,, ,, (three months)	23 3 9
Spelter (cash)	26 1 3
,, (three months)	26 3 9
Manchester—	
Copper, Best Selected Ingots	82 15 0
,, Electrolytic	84 15 0
,, Strong Sheets	108 0 0
,, Tubes (Basis Price), lb.	0 1 3
Brass Tubes (Basis Price), lb.	0 1 1
,, Condenser, lb.	0 1 3
Lead, English	24 12 6
,, Foreign	23 5 0
Spelter	26 5 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10 per lb.	
Ferro Tungsten	1/6½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 15 0	7/6
,, ,, 6 p.c. to 8 p.c.	£20 12 6	7/–
,, ,, 8 p.c. to 10 p.c.	£20 10 0	6/–
,, ,, Specially refined		
,, ,, Max. 2 p.c. carbon	£33 0 0	12/–
,, ,, ,, 1 p.c. carbon	£37 0 0	15/–
,, ,, ,, 0·70 p.c. carbon	£44 0 0	17/–
,, ,, ,, carbon free	1/– per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home; £13 10 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/– per unit	
,, ,, 75 p.c.	£19 0 0 scale 6/– per unit	
,, Vanadium	14/– per lb.	
,, Molybdenum	3/9 per lb.	
,, Titanium (carbon free)	1/– per lb.	
Nickel (per ton)	£170 to £175	
Ferro-Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.

(*Prices not stable.*)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	15/6
,, ,, Ell	18/6
,, ,, Splint	18/– to 19/–
,, ,, Trebles	16/6
,, ,, Doubles	16/–
,, ,, Singles	14/6
Ayrshire—	
(f.o.b. Ports)—Steam	17/6
,, ,, Jewel	18/6
,, ,, Trebles	17/6
Fifeshire—	
f.o.b. Methil or Burntisland—Steam	17/– to 17/6
Screened Navigation	19/6
Trebles	17/6 to 18/6
Doubles	16/6 to 17/–
Singles	14/6 to 15/–
Lothians—	
(f.o.b. Leith)—Best Steam	16/6
Secondary Steam	16/–
Trebles	17/6
Doubles	16/6
Singles	14/9

ENGLAND.

(8) N.W. Coast—	
Steams	23/–
Household	38/6 to 51/–
Coke	22/–
Northumberland—	
Best Steams	16/– to 16/6
Second Steams	15/–
Steam Smalls	10/–
Unscreened	14/–
Household	21/– to 27/–
Durham—	
Best Gas	15/– to 15/3
Second	14/3 to 14/6
Household	21/– to 27/–
Foundry Coke	20/– to 21/–
Sheffield—	Inland.
Best Hand-picked Branch	26/– to 27/6 —
Derbyshire Best Bright House	22/6 to 24/– —
Best House Coal	20/6 to 21/6 —
Screened House Coal	17/– to 18/– —
,, ,, Nuts	16/– to 18/– —
Yorkshire Hards	15/– to 16/– —
Derbyshire Hards	15/– to 16/– —
Rough Slacks	8/6 to 9/6 —
Nutty Slacks	4/6 to 6/– —
Smalls	3/6 to 4/– —
Blast-furnace Coke (Inland)	14/6 at ovens —
Furnace and Foundry Coke (Export), f.o.b.	19/– to 19/6

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	19/3 to 19/9
Second Smokeless Large	19/– to 19/3
Best Dry Large	18/6 to 19/–
Ordinary Dry Large	18/– to 18/6
Best Black Vein Large	18/9 to 19/3
Western Valley Large	18/6 to 19/–
Best Eastern Valley Large	17/6 to 18/3
Ordinary Eastern Valley Large	17/– to 17/6
Best Steam Smalls	13/6 to 14/–
Ordinary Smalls	12/– to 13/–
Washed Nuts	18/– to 24/–
No. 3 Rhondda Large	20/6 to 21/6
,, ,, Smalls	14/6 to 15/–
No. 2 ,, Large	17/6 to 18/–
,, ,, Through	16/– to 17/–
,, ,, Smalls	12/6 to 13/6
Foundry Coke (export)	27/– to 37/–
Furnace Coke (export)	19/– to 21/–
Patent Fuel	20/– to 21/6
Pitwood (ex ship)	26/– to 26/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	33/– to 35/–
Seconds	25/– to 29/–
Red Vein	22/– to 27/–
Machine-made Cobbles	40/– to 43/6
Nuts	36/– to 43/6
Beans	23/6 to 25/–
Peas	16/6 to 17/6
Breaker Duff	9/– to 9/6
Rubbly Culm	10/– to 10/3
Steam Coals:	
Large	17/6 to 18/6
Seconds	16/– to 17/–
Smalls	9/6 to 12/–
Cargo Through	15/6 to 16/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate 12/6 joists and 10/– all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our own Correspondent in Paris.)

Niger Hydraulic Works.

ALTHOUGH much has been said about the importance of the works that are to be undertaken in the valley of the Niger in order to render that vast territory a producer of all kinds of raw material for the home industries, little has been known about what is actually in progress. A programme is being carried out in a number of stages, the first of which is nearing completion, and has been visited by the Colonial Minister to the Niger. The works comprise the construction of a barrage near Bamako, which is the present terminus of the railway from Dakar, and a hydro-electric plant for supplying the town with light and energy. The railway will probably be electrified when completed. The barrage is constructed on the outskirts of Bamako at a point where navigation on the Niger is rendered impossible by rapids, and parallel to this stretch of the river an experimental canal has been constructed with a view of permitting navigation with the upper part of the river and of irrigating the low-lying territory between that river and the Bani. Another work is the construction of an embankment, across the valley above Sansanding, to prevent floods and, at the same time, to irrigate the territory lower down on the left bank of the Niger. The second part of the programme, which is to be completed in 1936, provides for the irrigation of territories to the North of Sansanding by means of a barrage and a system of canals. This is an important undertaking which, it is hoped, will permit of the creation of industries, particularly cotton growing, that will provide French manufacturers with the greater part of the raw material they need.

The Trans-Saharan Railway.

At the first meeting of the Commission, which has been appointed to examine all the various aspects of the proposed Trans-Saharan Railway and to report upon the feasibility of its construction, the President, Monsieur Steeg, explained that the Commission had to approach the problem with a perfectly open mind, and was required to make sure that, if the railway were put in hand, it would be constructed without risk of possible failure. As showing the value of the proposed undertaking, he referred to what had been done in Eastern Morocco, where the railway had completely transformed what had hitherto been a desert region. Amongst those present at the meeting were the Baron de Cuvellier, managing director of the Upper Congo Railway, who represented the Belgian Government, the Presidents of the Chambers of Commerce in France and in North Africa, and directors of the various home railways.

Railway Returns.

In 1921 the financial dependence of the railways upon the State was changed by the creation of the Conseil Supérieur des Chemins de Fer, which centralised the interests of all the railways, and was entrusted with the task of carrying out a system of organisation that would permit of the companies paying their way. The State withdrew its guarantee and refused any longer to make good the railway deficits. One duty of the Conseil Supérieur was to adjust the railway rates to cover the expenses and to create a fund whereby the surpluses of some companies would make up for the deficits of others. By 1926 the situation of the railway companies appeared to be desperate. The deficiencies each year had grown to an enormous figure. Drastic measures were taken to effect economies, and the railway rates were increased all round. In 1927 there was a turn for the better, and the provisional returns for 1928 show that the receipts of all the companies exceeded the expenditure, with the exception of the State Railways and the Midi. Notwithstanding the State deficit of 237 millions francs there was a total gain for all the companies of 645 million francs. Although the Conseil Supérieur was authorised to increase the rates, if necessary, there was nothing in the arrangement to justify its lowering them when there was an excess of receipts, and it is probable that a substantial fund will be created before there can be any question of relieving railway users.

Foreign Trade.

In analysing the returns of foreign trade during 1928, it is interesting to observe the changes that have taken place as the result of treaty arrangements and changes in the fiscal system, the latter having been made, in some cases, as much with a view creating revenue as to protecting home industries. Great Britain has always been by far the largest customer for French goods and products, and the decline of exports to that country by 2000 million francs is obviously a serious matter. The exports to Great Britain last year totalled 8165 million francs, so that the declension amounted to about 20 per cent. The imports from Great Britain were valued at 5447 million francs, representing a contraction on the previous year of 1000 million francs. At the same time, the United States sent goods to France to the value of 6200 million francs, and took from that country goods estimated to value 3331 million francs, there being in both cases a decrease as compared with the previous year. Again, Germany increased her consignments to France to 4961 million francs, and the exports from that country to Germany amounted to 5669 million francs, a declension of about 880 million francs. Business was fairly well maintained with such countries as Belgium, Luxemburg, Switzerland, Italy, Spain and the Argentine Republic, but the efforts to develop trade with Poland, Czecho-Slovakia, Roumania and other countries with which commercial treaties were entered into, did not give particularly satisfactory results. As for Russia the imports totalled 716 million francs, while the exports amounted to only 174 million francs. It is clear that the principal customers of France, while not sending so much to this country, are taking less of French goods, and while this coincides with the more rigorous fiscal tariffs it can only be assumed that they have some relation to this state of things.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

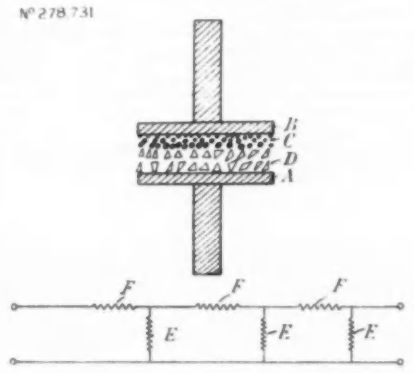
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

ELECTRICAL APPLIANCES.

278,731. October 6th, 1927.—IMPROVEMENTS IN RECTIFIERS FOR ALTERNATING CURRENTS, Manfred Singelmann, of Warmbrunnerstrasse 39, Berlin-Grunewald, Germany.

A and B are metal plates between which there are substances C and D, which, when combined, have a rectifying action. A combination of finely divided copper pyrites with finely divided zincite may be used. The circuit diagram shows a filter circuit which can, according to the inventor, be advantageously employed in conjunction with the rectifier. In the diagram, rectifiers E having progressively increasing resistances are connected up to act as transverse resistances, rectifiers F having progressively decreasing resistances being connected

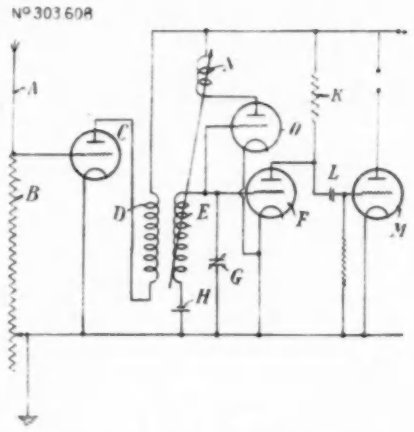


up to act as series resistances. The current can be taken off in known manner at the ends or at intermediate points of the filter circuit. The rectifying action is dependent on the pressure, in that as the pressure is increased the internal resistance decreases, while the rectifying factor either rises or remains constant. When the pressure is very great the value of the rectifying factor falls considerably. The same holds good with regard to the size of the grain. It is therefore necessary to select the pressure and size of grain to produce the best rectifying action. A rectifier made according to the invention may be mounted in the plug of a plug and socket device, the plug being made hollow and the rectifier accommodated in its interior.—*January 7th*, 1929.

TELEGRAPHS AND TELEPHONES.

303,608. November 9th, 1927.—WIRELESS RECEIVING CIRCUITS, The Edison Swan Electric Company, Ltd., of 123–125, Queen Victoria-street, London, E.C. 4; and Leonard Henry Soundy, of 8, Chester-gardens, Argyle-road, Ealing, London, W. 3.

One of the objects of this invention is to provide a selective receiver which is relatively free from trouble due to atmospheric interference. The aerial A is connected to earth through a non-inductive resistance B, suitable points on the resistance being connected to the grid and filament of a high-frequency amplifying valve C. Instead of the non-inductive resistance B any combination of inductance, capacity and resistance may be employed, so long as the aerial is not tuned to the frequency to be received. The anode of the valve C is connected to the positive terminal of the high-tension supply through an inductance D which is inductively coupled to an inductance E in the grid circuit of a second valve F, which acts as a detector. This inductance E is

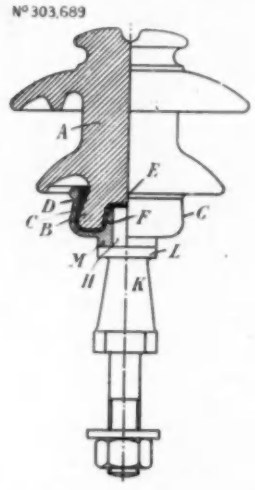


tuned by means of a variable condenser G and a suitable grid bias battery H may be included between the inductance E and the filament of the valve F. The anode of the valve F is connected to the positive terminal of the high-tension source through a high resistance K of about 5 megohms and through a condenser L to the grid of a low-frequency amplifying valve M. The grid circuit of an auxiliary valve O is connected in parallel with the grid circuit of the valve F, and the anode of this auxiliary valve is supplied with high tension through a reaction coil N coupled to the grid circuit inductance E. The remainder of the low-frequency side of the circuit may be arranged in any known or suitable manner. In operation, potential differences will develop across the resistance B in the aerial circuit owing to the incoming signals, but owing to the aperiodic nature of the aerial circuit there will be no selectivity. The auxiliary valve O, however, feeds back oscillations, through the magnetic couplings, and a highly selective combination is obtained. This system is extremely suitable for use upon short-wave lengths as well as upon the so-called broadcast wave length band. Its importance for short-wave work is, however, increased by the reduction of "static" interference which is obtained with the circuit.—*January 10th*, 1929.

TRANSMISSION OF POWER.

303,689. March 9th, 1928.—INSULATOR OF THE PINTLE TYPE FOR LIVE WIRES, Fritz Berg, of 13, Kepplerstrasse, Mannheim, Germany.

The invention relates to an insulator of the pintle type intended for live wires. A indicates the body of the insulator, which carries a conical head B at its lower end. The latter is connected by means of a metal filling D with a metal cap C. In the head B there is a recess E, in which a sleeve member F which

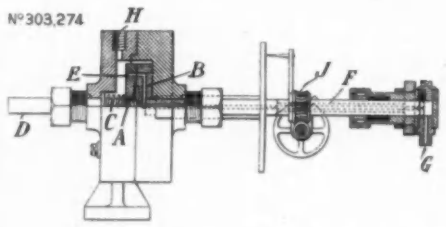


is formed in one piece with the cap G engages. In the sleeve F the stub H of an already known supporting pintle K engages, the flange L lying against the corresponding flange M of the sleeve F. The connecting pin H is riveted to the sleeve F of the cap. The connection can also be effected by threading the parts described or in any other suitable manner. The supporting pin K is connected directly with a bracket—not shown—of a live wire mast or with any other supporting member.—*January 10th*, 1929.

MEASURING AND TESTING INSTRUMENTS.

303,274. January 5th, 1928.—INDICATORS, C. R. Arcus, 9, Poplar-road, Ramsgate.

This instrument is intended for investigating the momentary pressure in the cylinder of, say, an internal combustion engine, at any period of its stroke. Two discs A and B are kept in contact with one another by the spring C. The disc A is rotated at engine speed by the shaft D, and has a port E. The disc B has

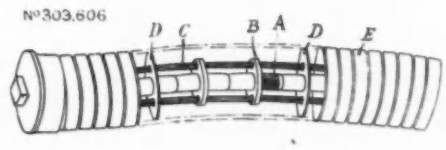


a port which communicates by means of the hollow shaft F and the branch G with the cylinder of the engine under investigation. The two ports in the discs coincide only once during a revolution, and then the pressure in the cylinder is transmitted to an indicator screwed into the casing at H. The point of coincidence can be varied by turning the disc by means of the screw gear J.—*January 3rd*, 1929.

LIGHTING AND HEATING.

303,606. November 8th, 1927.—IMPROVEMENTS RELATING TO ELECTRICAL HEATING UNITS, Robert Alfred Frederick Jackson, of 568, Maryhill-road, Glasgow; and James Douglas Place, of 23, Cranworth-street, Hillhead, Glasgow.

This invention relates to an electrical heating unit of the type comprising a metallic tube of the helically wound type and an electrical resistance element constructed as a flexible core to fit the tube. The invention is characterised by the feature that the core is constituted as a helical spring, a series of refractory insulator discs strung on the spring, and resistance wires threaded



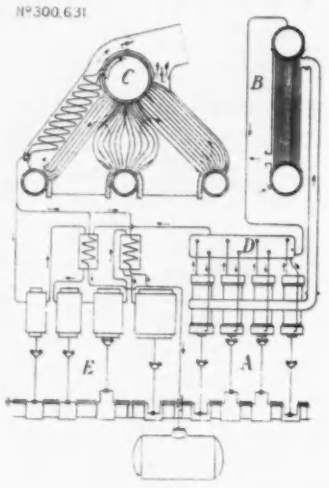
through perforations in the discs, the arrangement being such that the spring renders the core resilient and permits thermal expansion. The core shown comprises a helical spring A on which are strung a series of spaced refractory insulator discs B through which resistance wire elements C are threaded. D denotes spaced insulating discs also strung on the spring A and contrived to maintain the core central within a helically wound flexible metallic covering tube E. It will readily be understood that the spring A renders the core resilient and permits thermal expansion.—*January 10th*, 1929.

MISCELLANEOUS.

300,631. October 16th, 1928.—COMBINED TWO-PRESSURE STEAM POWER PLANTS AND INTERNAL COMBUSTION ENGINES. Schmidt'sche Heissdampf-Gesellschaft, mit beschränkter Haftung, Rolandstrasse 2, Cassel-Wilhelmshöhe, Germany.

This invention is somewhat difficult to understand, but

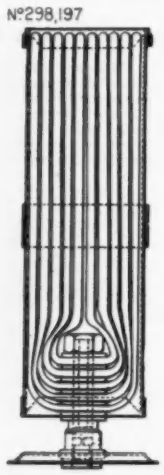
the fundamental idea underlying it appears to possess some merit. The idea is that if the water jackets of an internal combustion engine are used for the generation of steam, which is used in a parallel steam engine and is subsequently condensed, trouble may develop through the contamination of the water supplied to the jackets, on account of the leakage of sea water into the condenser. The inventors consequently isolate the heating systems and utilise the steam raised in the internal combustion engine jackets in a closed circuit to raise steam for the parallel steam engine in a separate boiler. The scheme involves



an elaborate system of heat transferrers. Thus, for instance, the heat of the exhaust gases from the internal combustion engine A is used in the feed water heater B, while it may be subsequently again utilised in an air preheater for the high-pressure boiler C. Steam raised in the jackets of the cylinders of the internal combustion engine circulates through coils in the steam generator D, and this steam is supplied to the cylinders of the parallel steam engine E. It will be observed that this steam is superheated by means of hot steam coming from the high-pressure boiler, while the first stage of that engine takes steam directly from that boiler.—*January 10th*, 1929.

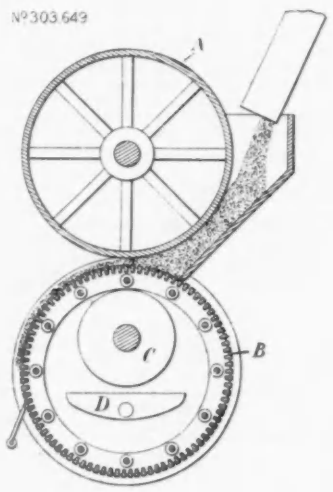
298,197. October 3rd, 1928.—OIL FILTERS, Tecalemit, Ltd., Mitre House, Scrubbs-lane, Willesden, N.W. 10.

As shown on the drawing, the filtering block is constituted of a number of separate elements in the form of pockets, the central part of each element being horizontal and the sides turned up vertically. Each member of each pocket is provided with a central hole, and the holes in the upper and lower members are each provided with an eyelet. These eyelets have spacers which serve to keep the two members separated and provide a space between the eyelets, allowing the flow of the oil into the filtering pocket. The pockets are piled on a central member screwed into an inlet union which communicates with the interior of the filtering pockets. The filtering block or assembly of filtering pockets is surrounded by a metallic gauze provided with reinforcement members as shown on the drawing. It will be easily seen that the different pockets are fed simultaneously with oil to be filtered, whereby they will work uniformly in filtering.—*January 10th*, 1929.



303,649. January 5th, 1928.—APPARATUS FOR SEPARATING FLUIDS FROM SOLIDS, H. Newall, 1, Walton New-road, Lower Walton, Chester; and J. Crossfield and Sons, Ltd., Bank Quay, Warrington, Lancs.

This machine is put forward as being especially suitable for



the expression of oil from oil seeds. It comprises two rolls A and B, between which the seed is fed as shown. The lower roll B is really in the form of a sleeve and is supported by the internal roll C. It is built up of bars or wires to provide for the passage of the expressed oil, which is caught by the trough D.—*January 10th*, 1929.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF ENGINEERING INSPECTION.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "Specification Notes and Good Practice Relating to Concrete and Reinforced Concrete Work," by Mr. A. S. Grunspan. 5.30 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS: NORTH-EASTERN CENTRE.—Hotel Metropole, Leeds. "Reduction of Weight in Rolling Stock," by Mr. G. H. Taylor. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's Gate, Westminster, London, S.W. 1. Informal meeting. Discussion on "Electrical Precipitation," introduced by Mr. G. Baker. 7 p.m.

INSTITUTION OF PRODUCTION ENGINEERS.—Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W. 1. Film, "The Story of a Sparking Plug." 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "The Application of the Heavy Oil Engine to Yachts and Small Craft," by Mr. J. Calderwood. 7.30 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—The Engineers' Club, 17, Albert-square, Manchester. Lectures: "The Metallurgical Aspect of Welding," by Mr. A. H. Goodger: "Welding in Relation to the Engineering Industry," by Mr. L. Miller; "The Application of Welding to Ship Repairing," by Mr. A. P. Traill. 7.15 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Mining Institute, Newcastle-upon-Tyne. Paper, "The Relations between the Properties of Engineering Materials and their Ultimate Structures," by Mr. G. W. Todd. 6 p.m.

PHYSICAL SOCIETY.—Imperial College of Science, South Kensington, London, S.W. 7. Papers: "The Construction and Calibration of a Sensitive Form of Pirani Gauge for the Measurement of High Vacua," by Mr. L. F. Stanley; "The Free Periods of a Composite Elastic Column or Composite Stretched Wire," by Dr. Charles H. Lees; "A Capillary Tube Method for the Simultaneous Determination of Surface Tension and of Density," by Dr. Allan Ferguson and Mr. J. A. Hakes. A demonstration of a standard electrostatic voltmeter and wattmeter, used for measurements of alternating currents at power frequencies at the National Physical Laboratory, will be given by Dr. E. H. Rayner. 5 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "Lily-stars of the Sea," by Dr. F. A. Bather, F.R.S. 9 p.m.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE.—Room 24, Royal Technical College, George-street, Glasgow. Paper, "The Response of Steels at Elevated Temperatures," by Dr. W. H. Hatfield. A cinema film entitled "The Age of Speed" will be shown. 7 p.m.

SATURDAY, FEBRUARY 23RD.

INSTITUTE OF BRITISH FOUNDRYMEN.—Grand Hotel, Manchester. Annual dinner.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS.—Newcastle-upon-Tyne. Papers: "Roof Control on Longwall Faces," by Mr. J. F. C. Friend; "Diamond Boring Applied to Tapping Drowned Areas Underground," by Mr. F. E. Smyth; "Land Drainage," by Mr. H. C. Pawson; "The Laws of Motion of Particles in a Fluid," by Mr. R. G. Lunnon. 2.30 p.m.

MONDAY, FEBRUARY 25TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Shaw Lecture, "Thirty Years' Experience of Industrial Maladies," by Sir T. Morison Legge. 8 p.m.

TUESDAY, FEBRUARY 26TH.

ENGINEERING GOLFING SOCIETY.—At the Institution of Mechanical Engineers, Storey's Gate, Westminster. Annual General Meeting. 12.30 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—39, Elmbank-crescent, Glasgow. Paper, "The Deformation of Metals," by Professor C. H. Desch. 7.30 p.m.

ROYAL SOCIETY OF ARTS: DOMINIONS' AND COLONIES' SECTION.—John-street, Adelphi, London, W.C. 2. "The South African Iron and Steel Industry," by Dr. H. J. Van der Byl. 4.30 p.m.

WEDNESDAY, FEBRUARY 27TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: NORTH OF ENGLAND CENTRE.—Engineers' Club, Albert-square, Manchester. "Some Investigations into the Performance of Tubular Radiators for Motor Vehicles," by Mr. H. Kerr Thomas. 7 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, London, S.W. 1. Students' meeting. Paper, "Pile Driving Formulas and Methods of Cast *in Situ* Concrete Piling, with Special Reference to the 'Vibro' Concrete Piling System," by Mr. E. C. Pound. 6.30 p.m.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION; INSTITUTION OF MECHANICAL ENGINEERS: MIDLAND BRANCH; INSTITUTION OF ELECTRICAL ENGINEERS: SOUTH MIDLAND CENTRE.—Midland Institute, Paradise-street, Birmingham. Annual joint meeting. Exhibition of cinematograph films of engineering interest. 7 p.m.

INSTITUTION OF WELDING ENGINEERS.—Chamber of Commerce, New-street, Birmingham. Paper, "Welding and Cutting Practice with Low-pressure Plant," by Mr. C. S. Milne. 7 p.m.

NORTHAMPTON ENGINEERING COLLEGE ENGINEERING SOCIETY.—St. John-street, London, E.C. 1. Walmsley Memorial Lecture, "Some Reminiscences of Engineering Work," by Dr. Oscar Faber. 4.15 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "Resins," by Mr. A. F. Suter. 8 p.m.

THURSDAY, FEBRUARY 28TH.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—Joint meeting with the Birmingham Metallurgical Society and the Staffordshire Iron and Steel Institute, in the Engineers' Club, Waterloo-street, Birmingham. "Metallurgy and the Evolution of the Balance," by Mr. W. A. Benton. 7 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: GRADUATES.—King's Café, St. Peter's-street, Derby. Annual dinner.

INSTITUTION OF AUTOMOBILE ENGINEERS.: GRADUATES' MEETING.—Royal Hotel, Mill-street, Luton. "Some Notes on Gear-box Design," by Mr. G. Baston. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Queen's Hotel, Birmingham. Annual dinner. 7 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Faraday Lecture. "How Electricity Does Things," by Mr. Ll. B. Atkinson. 6 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS.—Denison House, Vauxhall Bridge-road, London, S.W. 1. Paper, "Poppet Valve Performance," by Mr. O. Bulleid. 6 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Town Hall, Southall, Middlesex. South Midland District Meeting. 10.45 a.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "Physics in Relation to Oil Finding," by Professor A. O. Rankine. 5.15 p.m.

FRIDAY, MARCH 1ST.

INSTITUTION OF AUTOMOBILE ENGINEERS: GRADUATES' MEETING.—Regent Restaurant, 51, West Regent-street, Glasgow. "Inspection," by Mr. E. C. Philbrow. 8 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Meter and Instrument Section meeting. Paper, "The Rotor Bearings of Electricity Meters," by Mr. W. Lawson. 7 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS.—Frascati Restaurant, London. Annual dinner. 7 p.m.

JOINT DELEGATION OF THE LOCAL (YORKSHIRE) ASSOCIATIONS OF THE INSTITUTIONS OF CIVIL, MECHANICAL, ELECTRICAL, MUNICIPAL AND COUNTY, LOCOMOTIVE AND STRUCTURAL ENGINEERS.—Great Northern Hotel, Leeds. Fourth Joint Delegation dinner. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Lecture, "Notes on the Control of Electric Lifts," by Mr. L. S. Atkinson. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "Infra-red Spectra," by Sir R. Robertson, F.R.S. 9 p.m.

SATURDAY, MARCH 2ND.

BELFAST ASSOCIATION OF ENGINEERS.—Thompson's Restaurant, Belfast. Annual dinner. 6.45 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "Molecular Motions in Rarefied Gases," by Sir Ernest Rutherford, F.R.S. 3 p.m.

MONDAY, MARCH 4TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: GRADUATES' MEETING.—The College, Loughborough. "Lubrication," by Mr. G. L. B. Hall. 7 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: WESTERN CENTRE.—Merchant Venturers' Technical College, Bristol. "Air-cooled Engine Repairs and Lay-out," by Mr. A. H. R. Fedden. 6.45 p.m.

TUESDAY, MARCH 5TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: GENERAL MEETING.—At the Royal Society of Arts, John-street, Adelphi, W.C. 2. 7.45 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: GRADUATES MEETING.—Broadgate Café, Coventry. "Fistons," by Mr W. S. Ascough. 7.15 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, London, S.W. 1. Paper, "Impact in Railway Bridges, with Particular Reference to the Report of the Bridge Stress Committee," by Mr. Conrad Gribble. 6 p.m.

WEDNESDAY, MARCH 6TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Wireless Section meeting. Paper, "Single Wave Length Working," by Captain P. P. Eckersley and Mr. A. B. Howe. 6 p.m.

NEWCOMEN SOCIETY.—Demonstration Room, Ground Floor, Science Museum, South Kensington, London, S.W. 7. Paper, "A Comparison between French and English Windmills," by Mr. H. O. Clark. 5.30 p.m.

MONDAY, MARCH 11TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Queen's Hotel, Birmingham. "Some Investigations into the Performance of Tubular Radiators for Motor Vehicles," by Mr. H. Kerr Thomas. 7 p.m.

TUESDAY, MARCH 12TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: LONDON GRADUATES.—At Watergate House, Adelphi, W.C. 2. "Metal Omnibus and Car Bodywork," by Mr. D. Swallow. 7.25 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Rover Sports Club, Albany-road, Coventry. General meeting. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH MIDLAND CENTRE.—Hotel Metropole, Leeds. Annual dinner. 7.30 p.m.

WEDNESDAY AND THURSDAY, MARCH 13TH AND 14TH.

INSTITUTE OF METALS.—Institution of Mechanical Engineers, Storey's-gate, Westminster, London, S.W. 1. Twenty-first annual general meeting. For programme see page 130. 10 a.m. each day.

FRIDAY, MARCH 22ND.

INSTITUTION OF LOCOMOTIVE ENGINEERS: NORTH-EASTERN CENTRE.—Hotel Metropole, Leeds. "Experiments on Buffer Springs," by Mr. T. Robson. 7 p.m.

PRIZES FOR TURNERS.—The Worshipful Company of Turners of London will hold a competition in April, 1929, when prizes and rewards will be offered for turned work. Amongst the prizes there will be some for turning in metal and alloys, open to workmen, including mastermen and apprentices, in the trade in the United Kingdom; open to apprentices or students or scholars at any technical, industrial or other school or college, not over the age of twenty-one years on April 15th, 1929; open to amateurs; open to apprentices or students or scholars at any technical, industrial or other school or college, not over the age of sixteen years on April 15th, 1929.

SOUTH AFRICAN STUDENTS VISIT THE STAFFORD WORKS OF THE ENGLISH ELECTRIC COMPANY.—A party of students from the University of Cape Town visited the Stafford works of the English Electric Company, Ltd., on February 12th. The students, who were under the care of Professor A. E. Snape and Mr. G. Stewart, travelled from Euston in a special saloon, accompanied by a member of the company's export department. The tour of the works was carried out in accordance with a prearranged programme, and an expert was present in each department to explain the various processes and special features of design, further informal addresses on technical subjects being given later on in the Guest House. Before returning to London the party was entertained to dinner, and in speeches made by two of their number expression was given to the pleasure and satisfaction they had derived from what they had seen, and in finding that the company's establishment had no reason to fear comparison with the electrical works they had seen in Germany.